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THE DENVER CONVENTION.

We print elsewhere the full and revised programme of the Denver convention of the National Electric Light Association and may point out how thoroughly it covers the field of modern electric light engineering and management. In fact, it is rather difficult to see how all the work can be disposed of during the week unless many of the papers are read by title in order to allow room and time for discussion. In addition to the papers, themselves constituting a formidable bulk, there is a portly volume devoted to the "Question Box" and a "Wrinkles" department of great pith and moment. We do not see how any ambitious or inquiring central station manager can afford to stay away from such a convention, and we are glad to learn that the attendance promises to reach a very high mark. Locally, in Denver and Colorado Springs, all that is possible and proper has been done in the way of making preparations for entertainment, and altogether the Association is to be congratulated on the outlook for one of the very best meetings in its long history.

THE ELECTRIC LIGHTING SITUATION.

The central station man has never in the history of the art been confronted simultaneously with so many developments in the purely electric lighting branch of his field as at the present moment. What is more, at least one of these—that relating to the metallic filament incandescent lamp—carries with it a problem of the gravest import in connection with central station finances; for if its reported economy is realized in practice and it replaces the present carbon filament lamp, the income from lighting at present meter rates will be decreased not far from 40 per cent. In addition, the perennial rumor of a 2.5-watt lamp is again abroad, this time, however, accompanied with circumstantial details that give it greater weight than it has carried in the past. Its realization would mean a 20 per cent reduction in income on the basis of present meter rates. Then, we have the flaming or luminous arc lamp, which abroad has been meeting with much success and which has at last obtained a foothold in this country, with prospects of rapid extension. Finally, the mercury vapor lamp has definitely shown that it cannot be longer ignored, even in its present state, for some classes of exterior illumination and for the lighting of large interiors, where the peculiar quality of its light is not objectionable.

Bearing on the question of the metallic filament lamp, elsewhere we print a very interesting contribution from Dr. Louis Bell and Prof. W. L. Puffer, giving an account of some life tests on the tantalum lamp. As will be seen, on the basis of 600 hours' life the mean energy consumption of the lamps tested was about 2 watts per candle power, and the lamps did not fall below the standard 20 per cent of initial candle power until 850 hours of operation. In view of the record made by the new lamp on this test, the authors appear to be entirely justified in their conclusion that the life efficiency of the tantalum lamp is so great as to entitle it to an immediate and important place in the art. Another conclusion of the report is of particular significance to central station men—namely, that at any price below $1 per lamp the gain in energy consumption is so great that at ordinary prices of current, say, from 6 to 10 cents per kw-hour, the consumer could better afford to buy tantalum lamps than to get carbon filament lamps free. An inference from this statement is that if the tantalum lamp finally realizes all of its present promise

and is placed regularly on the market, even free renewal of carbon filament lamps will not prevent consumers from purchasing tantalum lamps at any reasonable figure; in other words, central stations would in that case either have to accept a 40 per cent reduction in income from lighting or engage in battle for an increase in meter lighting rates, with all the risk from governmental ownership or control that such a contest would imply. We may mention that a reported defect of the tantalum lamp is that owing to the shape of its resistance curve there is an inrush of current upon turning on the lamp which tends to shorten greatly its life. This same objection was originally brought forth soon after the announcement of the lamp, but the makers of the lamp later stated that tests in turning on and off the lamp at intervals of a few minutes had been found not to affect appreciably its life. We hope that this very important point may soon be made the subject of test by disinterested experimenters. Although the tantalum filament lamp has only been before the public since the beginning of the year, a rival has already been announced in the zirconium filament lamp, which is now being developed by one of the great German electrical companies. Details of this lamp will, it is stated, very shortly be forthcoming, and it is reported that these will show that the later lamp is in no respect inferior to the tantalum lamp. Surely, in view of the developments we have outlined above, the central station man has at the present moment cause for serious reflection.

How About Narrow Gauge?

We were glad of the opportunity in our last issue to stir up again the subject of cheap electric roads, by the publication of Mr. Cravath's paper before the Chicago section of the Institute. The recent financial sorrows of various interurban speculations have called out more forcefully than ever the necessary relation that must exist between the cost of a line and the gross receipts. One cannot invest $20,000 per mile of track and get $2,000 per mile on annual gross receipts without ultimate and generally not long delayed disaster. Indeed, if anything can be judged by experience, one must count on two or three times the amount mentioned in order to get anything like a paying proposition. A road costing not over $10,000 per mile built and equipped can live comfortably and pay dividends where a road of the ordinary sort would starve outright. That light railways can be built and equipped for such a figure is well known, and we are much obliged to Mr. Cravath for putting on record the details of an estimate for such light construction. These are days in which building of every sort is expensive. Even day labor on the construction is high, and altogether, if a road can be cheaply built as a whole in these days, it must be very skilfully planned. The basis of the figures given is a 28-inch gauge of 30-lb. T-rail, operating a single-phase equipment with extra light double truck cars.

Most engineers shy at a narrow-gauge plan in any form, and the influence of the salesmen would naturally be thrown against such an equipment. It is nearly impossible to find on the open market suitable motors for narrow gauge operations for direct current, let alone the alternating. For a gauge as narrow as 28 inches this difficulty would be very greatly increased. The real solution is probably in the use of alternating current motors. We are inclined to think, however, that for so light a roadbed it would be inadvisable to go to a maximum speed as great as 20 m. p. h. Twelve to fifteen m. p. h. would be a far better limit and would call for less power at the motor and in the power station. Whether it would not be better to go to a 36-in. gauge and to 35 or 40-lb. rails is open to question. The change would increase the cost by perhaps $1,000 per mile all told, but it might be worth the while. Of course, the casual critic at once suggests that narrow gauge is played out anyhow and that one had better go to "standard" construction. This question is open to debate, but it strikes us that there are lines which cannot be expected to grow indefinitely and that must be treated, not as the promoter wishes them to appear, but as they are. You might as well ask the Aqueedunk & Pogue Hollow R. R. why it does not relay its track with 90-lb. rail and run Pullman cars on its daily train. The fact is that there are times when one must cut one's coat according to the cloth or go without, and the best answer to scoffers is to point at the hopeless mess that has been made of cheap and hasty "standard" roads in cases that are now unpleasantly numerous. A road that starts out with no illusions and plans to do a small job thoroughly well will succeed better than one which is elaborately promoted for tasks that will never materialize.

There is surely a field of very respectable size for light railways, as we have more than once intimated. Mr. Cravath finds that by rigid economy a good narrow-gauge line can be built and equipped complete for a little less than $8,000 per mile, including a liberal allowance for contingencies. On this basis it is clear enough that the fixed charges, maintenance and depreciation charges no longer form the burden under which many roads are staggering and that a very moderate amount of earnings per mile will show a balance of the right sort. Earnings amounting in the gross to $2,000 per mile would mean sleek prosperity to a line built on this basis, while an ordinary line on these meagre pickings would soon be mourning in the hands of a receiver. Of course, freight carriage is a necessary function of a light road, and Mr. Cravath figures on a little less than $500 per mile of track from this source, which seems conservative. According to common experience, however, the amount of express, mail and miscellaneous incoming freighting, which last item Mr. Cravath neglects, should yield considerably more than he allows for it. Furthermore, in most sections of the country one could not build a 15-mile road without hitting a larger village population than Mr. Cravath allows for, so that, while his rural passenger receipts seem large to us, the difference should be more than made up on the village population. Perhaps the time is not yet ripe for truly rural railroading, but the opportunity for useful work and success is there, and it should not be long neglected.

The Mercury Arc.

We are glad to add to Dr. Weintraub's recent paper on the theory of the mercury arc his present discussion of some of its practical properties. Remarkably little information on this topic has been published, so that anything authoritative is especially welcome. We pass over here the brief historical sketch of the subject with which Dr. Weintraub's paper is prefaced. The early work does not seem to have been either significant or fruitful, and it is less than a decade since the subject was brought to notice in a striking way by Mr. Cooper Hewitt. The state of the art in the inventive sense seems to reside mainly in a multitude of more or less ingenious and useful auxiliary devices, mostly for starting the tube into action. To be brutally frank, if the mercury arc were a first-class, practical illuminant, the nature of the starting device would be a matter of very small consequence. Its luminous efficiency is so enormous as to outweigh many inconveniences, and with any reasonably effective starter, even if not wholly automatic, it would command an important place in the art of electric lighting. Even now it proves useful under favorable circumstances. As a general illuminant, however, it

stands condemned by its color, and until some escape from that difficulty is found the mercury arc will take a very subordinate position. No amount of preaching the unhygienic nature of red rays will help the matter any, even if the argument were wholly sound. Nevertheless, the mercury arc in its place is a good thing, albeit the place is at present a bit contracted.

Far more interesting and really important is Dr. Weintraub's discussion of the mercury rectifier, first made known by the work of Cooper Hewitt. The vital point in the rectifier problem is to keep the arc from going out, and, as is here shown, the essential thing is to keep a negative electrode permanently in the ionization business. This may be done by an auxiliary direct current, even a rather small one, or by depending on inductance to tide over the critical part of the cycle. When the mercury rectifier was first announced there was much talk of its use upon a large scale, of the rectification of current in quantity for railway and similar uses, and much more to the same effect. Now, all that was several years ago, and we do not yet note that the large electrical companies are refusing any orders for rotaries on the ground that they are now out of date. For some reasons not yet vouchsafed, but doubtless good and sufficient, the game does not seem to work as well upon a large scale, as regards current, as it does upon a smaller scale. Yet certainly one rather important use of the rectifier has appeared in the conversion of constant alternating to constant direct current for use in arc lights. Here the current is small, as in arc light dynamos, and the tube certainly works well, although, as Dr. Weintraub intimates, there are some difficulties in holding vacuum and so forth when working on a commercial scale. For arc lights, however, the conditions are favorable, and the somewhat pulsatory form of the resulting direct current is perhaps rather favorable than otherwise. Certainly it is a gain to be able to use direct-current arcs instead of alternating arcs on a series system.

As pointed out by Cooper Hewitt several years ago, the losses in the mercury rectifier were found to be relatively less as the voltage rises, which makes the series arc proposition especially attractive. We regret that Dr. Weintraub did not give an efficiency and power factor curve for the rectifier used in this connection, which would have given a clear idea as to whether one could increase the light obtained per kilowatt by rectifying the current. Of course, however, in cases where direct-current must be used, as in the flaming arcs, the rectifier should give a good account of itself. As a means of obtaining direct current for ordinary uses from an alternating service it is assuredly convenient, but the data given for its efficiency do not show any material gain over a simple rotary converter, which is very little more expensive and presumably of considerably longer life. At present mercury rectifiers are held at figures that do not encourage their extensive use, and they are thereby cut off from a very large field of usefulness. For instance, it would be an excellent thing if a constant potential rectifier could be used to operate direct-current motors from single-phase mains. In small sizes the direct-current motor has the advantage in efficiency, convenience, and particularly in price, but as things now go the cost of the direct-current motor plus the rectifier is so great as to put the combination out of consideration. It looks to us as though, however, the mercury arc and rectifier were due to arrive at very considerable commercial importance before long. Their investigation has been a tedious and serious task, and the results thus far obtained reflect great credit on the patient workers who have stuck by the game in spite of difficulties and discouragements. It will be a long time before the device gets fairly settled down into its appointed place in the electrical arts, but we feel sure that it has such a place, both in lighting and in current transformation. At the present time it looks as though the art were steadily growing more catholic and less serenely trustful of apparatus claiming universal applicability.

WHITE WALLS IN A PHOTOMETER ROOM.

The ordinary photometer room is a gloomy chamber with dull black walls and ceiling suggesting the vestibule of a mausoleum. Even the floor is sometimes reduced to the hue of lampblack. Some photometric observers are so far subservient to what they consider is a prerequisite in their work that they affect mourning during business hours, and enshroud themselves in a black mantle. One result of this superlative gloom is that it is sometimes difficult to read the setting of the photometer carriage for want of light on the scale. The article of Mr. E. P. Hyde on page 1034 of this issue is directed to dispelling this gloom, and to showing that the walls of a photometer room may be decorously ornate in color, or even white. This information will be welcome to many who contemplate installing a photometer, because the mourning tint of lampblack on all sides is usually an expense rather than an economy, and it takes more effort to be gloomy than to be reasonably gay.

The gist of Mr. Hyde's arrangement is to place screens of black velvet on the photometer, in such a manner than the only light which can reach the photometer carriage, except from the lamps under comparison, is diffused light reflected from the velvet screens. Under these conditions, if the reflective power of the velvet screens were absolutely nil—that is to say, if these screens absorbed all of the light that fell upon them from the walls of the room and from neighboring bodies—the photometer carriage would be pitch dark, even when the room was bright with diffused daylight. There would, of course, be the additional possible danger of diffused light reflected into the photometer carriage from the external surfaces of the lamp globes. But no black surface yet discovered absorbs all and reflects none of the light which falls upon it; so that the actual question is a quantitative and not a qualitative one. It is as to the amount of error which may be introduced into lamp measurements by the reflected light from the velvet screens under working conditions, considering such small reflective power as they undoubtedly possess, and the intensity of the feeble diffused light which falls upon them. Certain rooms with white walls, and a certain distribution of light sources, might produce serious photometric errors with particular kinds of velvet screens, whereas other rooms with other local conditions might never permit of any appreciable error. The measurements cited by Mr. Hyde indicate that in the case of his room the error due to reflection from the velvet screens is negligible, the stray illumination at the photometer representing an equivalent of only a few thousandths of a candle in the lamp to be tested.

Upon this result the photometer described is to be congratulated, since there is undoubtedly an advantage in working in an ordinary room instead of in a plumbago factory. Nevertheless, we think that it is erring on the safe side to paint all sides and furniture of the room with lampblack and turpentine. If this gloomy procedure is faithfully followed, there is no danger of errors from stray illumination. If the much more pleasant course be adopted of leaving white surroundings, it requires to be demonstrated by just such measurements as the article describes that the error introduced is negligible. This is especially true for photometers which are used experimentally and over wide ranges of movement, since in these it is difficult to provide stationary screens. Different settings and uses of the photometer may call for a marked change in the disposition of the screens.

The Programme of the National Electric Light Convention.

We print below the revised programme for the convention of the National Electric Light Association, to be held at Denver next week:

Tuesday, June 6—First session, 10 a.m., Convention Hall, Brown Palace Hotel. Address of welcome, the Mayor of Denver. President's address, Ernest H. Davis, Williamsport, Pa. (1) Report, Progress, T. Commerford Martin, New York. (2) "The Paramount Importance of Choosing Standard in Preference to Special Machinery," David Hall, Cincinnati, O. (3) "Insulation Testing, Apparatus and Methods," C. E. Skinner, Pittsburg, Pa.

Tuesday, June 6—Second session, 2 p.m. (4) "Automatic Synchronizing of Generators and Rotaries for Lighting and Power Systems," Paul MacGahan, Pittsburg, Pa. (5) "Notes on Rotary Converters and Motor-Generators for Lighting and Power Systems," Louis E. Bogen, Cincinnati, O. (6) "The Organization of Working Forces in Large Power Houses," W. P. Hancock, Boston, Mass. (7) Report, Committee on Steam Turbines," W. C. L. Eglin, chairman, Philadelphia. (8) "Operating Features of the Curtis Steam Turbine," A. H. Kruesi, Schenectady, N. Y.

Wednesday, June 7—Third session, 10 a.m. (9) "Series Alternating-Current Motors for Industrial Work," Clarence Renshaw, Pittsburg, Pa. (10) "A New Type of Single-Phase Motor for Elevator Work," S. Percy Cole, St. Louis, Mo. (11) "Long-Distance, High-Tension Transmission in California," John A. Britton, San Francisco, Cal. (12) Report, "Present Methods of Protection from Lightning and Other Static Disturbances," Alex. Dow and R. S. Stewart, Detroit, Mich. (13) "The Nernst Lamp; Its Present Performance and Commercial Status," E. R. Roberts, Pittsburg, Pa. (14) "The Choice of an Insulated Cable," Wallace S. Clark, Schenectady, N. Y.

Wednesday, June 7—Fourth session, 8 p.m. (15) "Some Investigations of Induction Losses," E. P. Dillon, Colorado Springs, Colo. (16) "Mercury Arc Rectifiers," P. D. Wagoner, Schenectady, N. Y. (17) Report, "Advertising Methods," Percy Ingalls, Newark, N. J. (18) Report, "Sign and Decorative Lighting," La Rue Vredenburgh, Boston, Mass. (19) "Free Signs and Flat Rates," C. W. Lee, Newark, N. J.

Thursday, June 8—Fifth session, 10 a.m. (20) Report, "Progress of Electric Heating," James I. Ayer, Boston, Mass. (21) Report, "Purchased Electric Power in Factories," E. W. Lloyd, Chicago, Ill. (22) Report, Committee on District Steam Heating, W. H. Blood, Jr., chairman, Seattle, Wash. (23) "Wrinkles," H. C. Abell, editor, New York City.

Thursday, June 8—Sixth session, 2 p.m. (24) Report, Committee on Relations with Kindred Organizations, James I. Ayer, chairman, Boston, Mass. Executive session. (25) Report, Committee on Rates and Costs, Charles L. Edgar, chairman, Boston, Mass. (26) Report, "Municipal Ownership," Arthur Williams, New York, N. Y. (27) "Question Box," Homer E. Niesz, editor, Chicago, Ill.

Thursday, June 8—Seventh session, 8 p.m. Executive session. Report of secretary and treasurer. Report of Executive Committee. Report of Committee on Relations between Manufacturers and Central Station Companies, Henry L. Doherty, chairman, Denver, Colo. Report of Committee on Standard Rules for Electrical Construction and Operation, Charles L. Edgar, chairman. Election of officers. During the convention, Dr. Louis Bell will present a report on the tantalum lamp.

The entertainment of delegates will include a theatre party at the Elitch Summer Gardens, a luncheon at the Denver Country Club for the ladies, followed by a drive about the city. The ladies will also be entertained at the Orpheum Theatre during an evening session of the convention and after this session the men will be entertained at a smoker. During the week there will be golf matches at Colorado Springs, with one prize for men and one for ladies.

One afternoon will be devoted to a broncho-busting contest. Great care has been taken in selecting for this typical Western exhibition the best horses and men to be found in Wyoming, Colorado and Mexico.

On Friday morning the entire party will be taken to Colorado Springs on special trains. During Friday afternoon there will be drives to points of interest about Colorado Springs, Glen Eyrie, Garden of the Gods, Cheyenne Canons, over the Bear Creek Canon road to Bruin's Inn; also visits to the power plants of the Colorado Springs Interurban Railway Company, the Colorado Springs Electric Company, the Curtis Company's lignite coal mines, the reduction mills at Colorado City, the Pike's Peak Hydro-Electric Company's hydraulic plant at Manitou, from which point the delegates may take the "Cog Road" to Pike's Peak. In the evening there will be a concert at the Broadmoor Casino.

Saturday will be given to an all-day trip to Cripple Creek, through the most beautiful scenery in Colorado. On Sunday such of the delegates as desire to do so will have an opportunity to take trips mentioned for Friday afternoon, as it will be impossible for all these trips to be taken in one day.

The headquarters of the association will be at Brown Palace Hotel. This hotel will not accommodate all the delegates, but there are a number of other first-class hotels in the immediate vicinity, where the hotel committee will place those making application too late for rooms at the Brown. Reservations should be made through Mr. Frank Farrar, committee's secretary, 405 Seventeenth Street, Denver.

The special train arrangements have already been noted. The chief special is that from the East, leaving New York City at 10.25 a.m. on Saturday, June 3, over the Pennsylvania and then by the Burlington route (C., B. & Q.) from Chicago to Denver. This train will comprise baggage car, composite car, dining car, sleepers and library car, with observation compartment and platform.

The whole plan is for economy of time and increase of comfort and pleasure where it is possible. The route will lie through New Jersey, Southern Pennsylvania, Central Ohio, Northern Indiana, Northern Illinois, Southern Iowa and Central Nebraska. The return will be via this or other direct routes, as the special is to be abandoned at Denver in order that its passengers may return when they individually please, instead of on a set date. It should be borne in mind that the Burlington route has a line eastward from Denver via St. Joseph, Kansas City and St. Louis. This will be available for any who prefer to give diversity to the journey. There will be no additional charge for returning via any of these points.

The cost of round-trip tickets to Denver, Colorado Springs or Pueblo, from the various points will be as follows: New York, $56.70; Chicago, $30; Peoria, $26.75; St. Louis, $25. Tickets will be sold from Eastern territory at reduced rates based on the above. The cost of sleeping car accommodations to Denver on the special will be: From New York, double berth, $11; section, $22. From Philadelphia, double berth, $11; section, $22. From Harrisburg, double berth, $10; section, $20. From Pittsburg, double berth, $8.50; section, $17. From Chicago, double berth, $6; section, $12.

It will be noted that accommodations on this handsome electric-lighted special will be no more expensive than service on ordinary trains, and that tickets can also be made to read to Colorado Springs or Pueblo without any additional charge. In view of this fact it will scarcely be necessary to urge members to use the special. Inquiries or requests for reservation should be addressed by Eastern applicants to Colin Studds, passenger agent of the Pennsylvania Railroad, 263 Fifth Avenue, New York City, or W. W. Lord, Jr., passenger agent of the Pennsylvania, at 1411 Chestnut Street, Philadelphia. The Pennsylvania and Burlington Route sections are to be consolidated in Chicago, and reservations for those who will start from Chicago should be made through Frank L. Perry, assistant manager of transportation, care of the *Western Electrician*, 510 Marquette Building, Chicago, or F. E. Bell, city passenger agent of the Burlington Route, 211 South Clark Street, Chicago.

Electricity on the Reading Railroad.

At a conference held in Philadelphia last week George F. Baer, president of the Reading Railroad, told a committee of residents that he contemplated adopting electricity as a motive power for urban and suburban service, though retaining steam for the movement of expresses into and out of the city. It is the purpose of the Reading Company to build an elevated structure in Ninth Street, Philadelphia, capable of carrying four tracks. After it is completed the operation of electric trains on the outermost tracks will be commenced.

Electrical Consolidation in Germany.

The tendency toward the consolidation of leading electrical firms in Germany is marked by the recent step of the firm of Felten & Guilleaume, of Mülheim-on-Rhine, in taking over the manufacturing portion of W. Lahmeyer & Co., of Frankfort-on-Main. The style of the new firm is Felten & Guilleaume-Lahmeyer Werke Aktiengesellschaft. The capital of the concern has been made 55,000,000 marks, the new shares being issued at 110.

It is the manufacturing part of the Lahmeyer Company that enters into the new combination, while the Elektricitäts-Aktien-Gesellschaft vorm W. Lahmeyer & Co. as a firm still continues to exist and assumes the character of a finance institution, and will remain in touch with the new Felten & Guilleaume-Lahmeyer Works in so far as they receive as an equivalent for the surrender of their manufacturing business a corresponding proportion of the shares of the new company.

The transaction was concluded on the basis of the status of the Lahmeyer Works on March 31. The Elektricitäts-Aktien-Gesellschaft vorm W. Lahmeyer & Co., in addition to the 17,000,000 marks shares taken over of the new company's shares retain possession of their investments representing in the balance sheet of March 31, 1904, a value of 20,980,006 marks. They also retain their undertakings, figuring in the last balance sheet for 8,745,886 marks. Their capital of 20,000,000 marks and obligations of 12,975,000 marks remain unaltered.

During the last four years the Lahmeyer Company paid in dividends 10, 0, 0 and 2½ per cent, respectively. The firm of Felten & Guilleaume, Carlswerk, whose style is changed to Felten & Guilleaume-Lahmeyer Werke, was converted into a limited company at the beginning of 1900, with a capital of 30,000,000 marks, increased at the end of the same year to 36,000,000 marks. This firm has been the property of the Guilleaume family for more than 75 years. Since the conversion into a limited company dividends of 10, 0, 5 and 5 per cent have been declared for the years 1900, 1901, 1902 and 1903, respectively. For the year of 1904 a dividend has just been declared of 8 per cent.

The shares of the Felten & Guilleaume Company have hitherto been held exclusively by the Guilleaume family, and this will continue to be the case. The board of directors was hitherto composed of Messrs. Theodore and Max von Guilleaume and Mr. Justirrat Heiliger, all of Cologne.

The works of Felten & Guilleaume Carlswerk employ about 5,000 hands, and engines of 5,500 hp. Their principal manufactures are wires and wire products. In addition the cable factory is one of the most prominent branches. The Lahmeyer Company has been chiefly engaged in the manufacture of dynamos, in connection with which they enjoy a very high reputation.

The Allgemeine Elektricitäts-Gesellschaft and the Union Elektricitäts-Gesellschaft have been united for some time past, as also the Siemens-Schuckert group. The German electrical industry is by this latest combine divided into three important groups.

Novel Feature of an Automobile Club.

The Automobile Club of America is to have a beautiful and ingenious club house in New York City, near Central Park. The building committee has for its chairman Dr. S. S. Wheeler, president-elect of the American Institute of Electrical Engineers, who is also the consulting engineer for the club. The building is to include not only club quarters, but large automobile charging and storage capacity.

In the basement will be an electric steam turbine generating plant with ample coal bunkers under the sidewalk, with the engines, pumps and other operating machinery next, and in space brightly lighted by the sidewalk vaults lights and with boilers facing toward the street so that the coal and ash-handling will be in direct line. Under the vault will be the gasoline storage, sub-divided into numerous tanks, so that the contents of each will not exceed the amount prescribed by the Fire Department. These tanks will be filled from pipes terminating at the curbstone line, so that the filling pipe from the gasoline wagon will not cross the sidewalk and the gasoline will be conveyed to the automobiles by measuring pumps which deliver exactly one gallon at each stroke.

The electric elevators will be of four tons capacity, or ample to take any car that has been built, and will have platforms 10 by 18 ft. These will be covered with a non-absorbent, fire-proof, glazed covering and the sides will be of iron. The gates to the elevator doors will be provided with automatic arrangements whereby it will be impossible to open the elevator gate unless the elevator is at the landing, or start the elevator except when the gate is closed.

On the storage floors there will be movable partitions with screw bases to partition off stalls for those who desire to keep their cars in a locked space.

The repair department and machine shop have been located on the top floor, which will be practically entirely surrounded by glass in addition to having a skylight. This department will be equipped with the most modern machine tools electrically driven, and in charge of an expert who will do machine work for the chauffeurs or owners, and a large space will be provided in which chauffeurs may take apart and examine their own cars, passing through a gate to the machine foreman such parts as they wish to have expert machine work done on. In this department will also be the club dynamometer, which will be arranged to take the full measurements of efficiency, fuel consumption, power, etc., of all makes of cars. Upon the designing of this special apparatus, arranged particularly for convenience and the rendering of quick readings, the technical committee has given a great deal of attention, and it is expected to be quite a feature.

The elevators are arranged to run to the roof level in case it is desired for any reason, such as photography or extra storage, to carry cars to the roof. The elevators and stairways are separated from the rest of the building by a fire wall with large automatic fire doors at each floor, and with one connecting to the main assembly room, so that it will be possible to bring up cars and run them into this room to illustrate lectures. The building will be equipped with a complete electric light and power wiring, including circuit for demonstration in the lecture room, with watchman's signals, telephone system and enunciators throughout.

There will be no illuminating gas in the building, and safety from breakdown in the electric service, and also night service, will be provided for by a storage battery in the basement. The construction in general of the building will be reinforced concrete, and the building itself will be absolutely fire-proof throughout. Experiments having demonstrated that the most effective way of putting out burning gasoline is by throwing sand on it, all of the columns in the building will be provided with hooks on which will be hung buckets of sand (in place of water) and tubes containing the usual fire extinguishers.

Electrical Units

Prof. Hospitalier, in *L'Industrie Electrique*, in reviewing the recent discussion before the British Institution of Electrical Engineers on electrical units, criticises severely the system proposed by Prof. Giorgi, which formed the subject of a paper read at the St. Louis International Electrical Congress. This proposed system is based on the adoption as fundamental units of the meter, the kilogramme and the second. Prof. Hospitalier pronounces this to be irrational and incoherent because it is based on fundamental units not consistent with each other, and because it necessitates the employment of units of abnormal value and the introduction of parasitic factors. In this system, for example, the unit of density is the kilogramme per meter cube, and the density of water becomes equal to 1,000. The unit of force is 10^5 and has no special name. As to the parasitic factors, resistivity is taken as an example. To apply the formula giving the resistance of a conductor as a function of its dimension expressed in meters, it is necessary to express the resistivities in ohm-meters, and necessitating consequently either a modification of all known tables or the introduction of a parasitic factor which is a multiple of 10. The same follows in the case of a large number of other physical units.

In conclusion, Prof. Hospitalier says that the system of Prof. Giorgi, which the author calls an absolute practical system, is, in his opinion, a bastard system having in its favor neither the logic of the c.g.s. system nor the traditions of the practical system, at the same time possessing all the inconsistencies of the latter, which its adoption would perpetuate.

Tests of the Tantalum Lamp.

By Dr. Louis Bell and Prof. W. L. Puffer.

Shortly after the first announcement of the new lamp, one of us was fortunate enough to receive through the courtesy of Mr. E. D. Adams ten 110-volt, 25-hefner tantalum lamps, which it has seemed wise to subject to rather searching tests not yet completed, but far enough along to permit a preliminary report. These tests included first photometric determinations of all the lamps, trial of the light distribution and finally a decay test to determine the variation of candle-power and efficiency with life. The work was done in the Lowell Laboratory of the Massachusetts Institute of Technology.

All the photometric work was done in the photometer room of the laboratory, which is fitted up with a 200-in. photometer bar with rotary socket fitted for operation at all angles, delicate and recently calibrated Weston instruments, checked from time to time against standard cells, and with very complete and convenient apparatus for holding constant voltage upon the circuits. All tests were by the method of substitution, the lamps being on the same circuit furnished by a special motor-generator, and the required voltage difference, if any, was shown by throwing the voltmeter into differential connection.

The standard of light employed was a certain standard incandescent lamp from the Institute equipment which for the purposes of this test was recalibrated by comparison with the following standards of reference: First, two standard lamps certified by the Lamp Testing Bureau and available through the courtesy of the Edison Illuminating Company, of Boston; second, a recent standard of the Lamp Testing Bureau kindly lent us by Prof. Kennelly; third, a General Electric standard of the Harrison Lamp Works, from the same source; and fourth, an Institute standard freshly evaluated by comparison with three Hefner lamps from the Reichsanstalt. The mean of these comparisons was taken as the working value of our standard lamp No. II, which in such terms gave 16.85 cp at 109.4 volts in its marked azimuth. Of the tantalum lamps available six were in clear globes and four in frosted globes. They corresponded in dimensions and general arrangement with the original published description of these lamps. Under the microscope the wire looked uniform and homogeneous and fairly smooth for so fine a wire. The steel wire spiders held the loops rather loosely.

We found the lamps to give a substantially circular distribution in the horizontal plane, the readings in rotation and in various azimuths not varying appreciably. The vertical distribution of these clear lamps does not vary materially from that in the frosted lamps tested by Prof. Kennelly, and is shown in Fig. 1. It could be materially

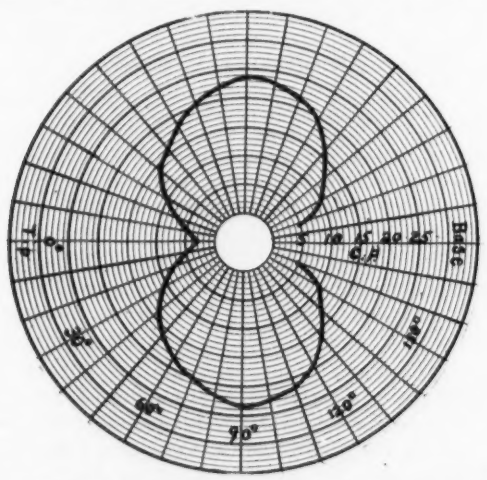


FIG. 1.—VERTICAL DISTRIBUTION OF LUMINOUS INTENSITY.

improved by shortening the arms of the upper spider, or by making similar obvious changes in the arrangement of the filament.

In the photometer the six clear lamps gave an average of 22.20 cp at an average of 1.85 watts per candle. The watts per lamp varied in the several lamps from 38.61 to 41.91.

The four frosted lamps gave an average of 19.08 cp at a mean of 2.1 watts per candle, consuming from 40.04 to 40.48 watts per lamp. From ten similar frosted lamps Prof. Kennelly found a mean candle-power of 19.20 at 2.1 watts per cp, a figure that checks our own with singular precision.

From the six clear globe lamps we chose the two which most nearly represented the mean of the six in watts, candle-power and efficiency for a decay test. A three-light cluster was set up and in it were placed the tantalum lamps E and F with a fresh 16-cp, 110-volt Edison lamp taken at random from a stock lot reputed to be 3.6 watts per candle. The cluster was then wired to the laboratory bus-bars of 115 volts, a small non-inductive resistance being inserted to give just 110 volts at the lamps. A recording voltmeter, frequently checked by measurement with Weston instruments, enabled continuous track to be kept of the voltage. It averaged extremely close

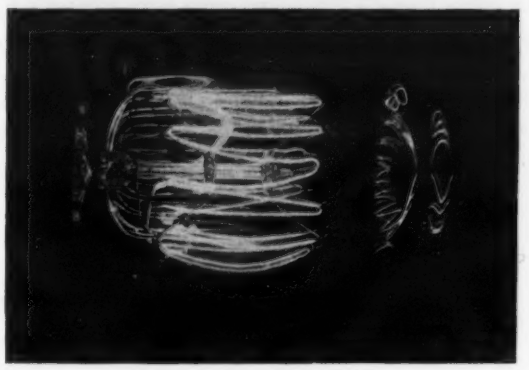


FIG. 2.—INCANDESCENT FILAMENT.

to 110 volts, swinging from time to time quite impartially a couple of volts above or below this mean. The conditions in our opinion represented accurately those on a good commercial circuit held upon the average fully up to its rated voltage. The bus-bars were normally on direct current, but for a few afternoons of which only a partial record was to be kept, they were thrown upon a 60-cycle alternating machine.

After a few hours of burning the nearly horizontal tantalum filaments began to sag perceptibly and became quite loose for a time, apparently owing to the complete annealing of the wire. The stretching reached a maximum after about 100 hours, at which time the filament presented the appearance shown in Fig. 2. This figure was obtained, by the way, by photographing the glowing lamp in the photometer room, "Isolar" plates being used to avoid halation. The picture shows a deep bow in the lower loop and also exhibits the cooling effect of conduction to the spider arms close to the contacts with them. After a few hours' burning, too, the filament began to show bright spots and later took on a somewhat lumpy appearance. After two or three hundred hours the sag in the filaments began to come up and eventually the filaments were tightly drawn, making

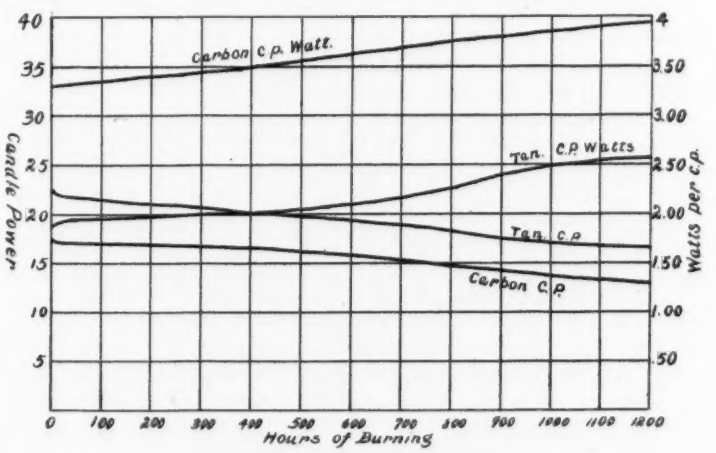


FIG. 3.—CANDLE-POWER CURVES.

sharp angles at the supports save in some occasional loops. This drawing up seems to be connected with increasing lumpiness of the wire, which continued until at the end of the test it was very striking—exactly as shown in the magnified bit of filament pictured in the original announcement of the lamp. In general our tests fully confirm the statements there made about the lamp.

The decay test was carried on with few interruptions, the lamps being removed for test about every one hundred hours. After about 600 hours the filaments seemed to be drawing quite tight and we were in daily expectation of a break. Nothing happened, however, and the lamps burned steadily on, losing candle-power rather slowly.

They went for a little over 850 hours before falling to 80 per cent of the initial candle-power, a point of decay reached by the carbon lamp only a few hours later. From this point the decay seemed rather more gradual and at 1,117 hours all the lamps were still intact. At 1,190 hours they were still burning brightly, but a close examination showed that the filament of the tantalum lamp of Fig. 2 had given way and had automatically welded itself together again within about 2 mm. of the break. The break had occurred close to the spider and the falling end had caught against the other side of the loop and had made a secure weld, leaving the short end as a hook over the spider to keep the new arrangement in position. How long the lamp had burned in this way we do not know, but it was put through the usual measurements and the test was then called off.

Fig. 3 shows the result of the decay test with the mean candle-power and watts per candle of the two tantalum lamps, plotted with which are the same data for the carbon filament lamp tested with them, which made a most excellent record.

It will be seen that the tantalum lamps stood for 800 hours with a mean candle-power of 20 at about 2.05 watts per candle, thus giving an effective life of about 16,000 candle-hours. At 2.15 watts per candle one could count on about 19 cp average for 1,000 hours, while for about 600 hours the mean energy consumption was fairly down to 2 watts per candle-power.

It is sufficiently obvious that if these lamps are anywhere nearly typical examples of the tantalum lamp, its life-efficiency is so great as to entitle it to an immediate and important place in the art. At any price below $1 per lamp the gain in energy consumption is so great that at ordinary prices of power, say from 6 to 10 cents per unit, one could better afford to buy tantalum lamps than to get carbon lamps free, to judge from the results of our experiments. We are continuing our work particularly with reference to operating the lamps on alternating current, some doubts having been expressed as regards their endurance on such circuits. Stroboscopic experiments which we have tried do not indicate unusual variability of the light, the results at 25 cycles being similar to those obtained from 10-cp carbon lamps of similar voltage, and the tantalum lamps which we have working on alternating circuits at 60 cycles have not yet been going long enough to give a basis of judgment. But certainly for a new article the endurance of the lamp as tested is very gratifying. We have received also samples of 120-volt lamps which we hope to test later. Meanwhile, this preliminary report will at least add something to the as yet scanty stock of knowledge regarding the most interesting innovation of recent years in incandescent lighting.

Three Thousand Kilowatt Plant for the White City, Chicago.

The Commonwealth Electric Company, Chicago, has established a sub-station with a present capacity of 3,000 kw to supply the White City, a large pleasure resort on the order of Dreamland, at Coney Island, which was opened to the public May 27. This is the largest resort of its kind in the United States, which can well be imagined from the enormous power and light consumption. The decorative lighting of the White City, which is on the order of recent exposition lighting, is very fine. About half of the power required is for exterior decorative lighting of the buildings and the other half for interior lighting and the operation of motors in connection with the various concessions. The sub-station is equipped with 1,000-kw rotary converters. Two of these have been installed and the foundations and wiring are ready for a third. The sub-station building is large enough to take four 1,000-kw units. The building was erected by the White City Company, and the electrical installation made by the Commonwealth Electric Company, which furnishes the power. The Commonwealth Electric Company will arrange the sub-station so that visitors can see the apparatus through a glass partition, and there will be an electric demonstration room for various electrical devices. Admission to this will be free. The sub-station is supplied with power over a 9,000-volt, three-phase, 25-cycle transmission line, running direct from the company's large steam turbine plant at Fisk Street, by way of the Fifty-sixth Street Station. The rotary converters are supplied through 1,100-kw, three-phase, air-cooled transformers. These rotary converters give 230 volts direct current for supplying a 115-230-volt, three-wire, direct-current system.

The White City is located at Sixty-third Street and South Park Avenue, which is far outside the company's direct-current district, but it was decided to use direct rather than alternating current for this, for two reasons: one being that many of the concessions already had direct-current motors and apparatus, and the other was that the apparatus in this sub-station could readily be utilized in any direct-current sub-station of the Chicago Edison Company, should the White City be discontinued at some future time. To have supplied such a large capacity as required by the White City with 60-cycle, alternating current, which is the current supplied in the district where the White City is located, would have required a great addition to the company's 60-cycle apparatus, which could not be so quickly utilized on other work. To supply 25-cycle, alternating current, would have introduced other objections. The alternating-current ends of the rotary converters are star-connected with grounded neutral, and this neutral is connected to the neutral of the three-wire, direct-current system. This arrangement allows any slight unbalancing of the three-wire system to be taken care of. Further unbalancing can be disposed of with the generator of an induction motor-generator set used for starting the rotary converters. This motor-generator set has a 125-hp induction motor driving a 9-kw generator. The electrical engineer of the White City during construction was Mr. G. H. French.

May Meeting of the New York Electrical Society.

At the May meeting of the New York Electrical Society, held May 24, Mr. Charles A. Mudge, formerly chief engineer of the railway department of the Allgemeine Elektricitäts Gesellschaft, of Berlin, who took part in the high-speed electric tests on the Berlin-Zossen road, lectured on "High-Speed, Long-Distance Electric Traction." Mr. Mudge gave full particulars of the Berlin-Zossen equipment and trials, accounts of which have appeared in these columns. Referring to the details of the trials, it was stated that no difficulty was found in collecting currents at voltages up to 14,000, but some trouble at first was experienced keeping the sliding bows on the trolley wires, this, however, being mainly due to the vibration either of the car or the wires rather than to any fault in the design of the trolleys themselves. The tests showed positively that if a car is run, for example, at 50 miles per hour, one can expect a maximum air pressure of about 7 pounds per square foot at the front of it; and if the speed is doubled we get four times this pressure and if tripled nine times this pressure. If the nose of the car is properly shaped this pressure may be reduced 10 per cent. Also, if a 100-ton car is run at a speed of 50 miles per hour on a level track it will take about 150 hp; when the speed is doubled it will take six times this amount of power, while if the speed is tripled eighteen times the amount of power is required. In the earlier trials at high speed the car took on a swinging lateral motion which at times became so pronounced as to create a feeling of insecurity in the passengers. The cause of this was found to be the unsymmetrical position of the weight of part of the equipment, which was counteracted by placing weights along the floor, after which no further vibration was noticed, the car running even at the highest speed as smoothly as a Pullman. While the working of the trolleys was satisfactory after proper adjustments, it was evident that a more substantial trolley construction would have to be adopted for commercial high-speed work. The braking results were not very satisfactory, the enormous brake pressures available at high speed giving a low retardation.

Mr. Mudge enumerated the following points as those which have to be considered in dealing with high-speed work: (1) Keep the car body as near the rails as possible; (2) arrange all heavy pieces of apparatus so that their centers of gravity lie in the center of the car, or in symmetrical relation therewith, and as near the earth as possible; (3) all apparatus mounted above the car floor should be as light as design will permit; (4) make the overhead trolley contact above, in preference to the side of, the car; (5) support the motors flexibly on the axles of the trucks; (6) give the front end of the car a wedge shape; (7) support the car body on the truck frame at some distance from the center bolt, and allow it a flexibility in a line at right angles to the track, independent of the truck; (8) make the total wheel base of the truck of ample dimensions, and not less than 20 per cent of the length of the car; (9) build the road as straight as possible, and where more than one track is used make them farther apart than present practice; (10) on curves make the approaches of the elevated side of the track longer than present practice.

Mr. Mudge said that if it were possible to have the wheels along the sides of cars and the rails between the floor and roof lines, there would be much more comfortable travel at high speeds; and that any condition approaching this, as by keeping the car body near the rails, would share in this benefit. The idea of having the trolleys on six separate poles does not seem to be as good as the use of two poles. In the latter case the trolleys would lie directly above each other and in taking curves and supports they would all strike together, making it easier to keep on the wires as the car turned.

In passing stations at 125 miles per hour, it was not possible to recognize persons standing upon the platforms, and on dark and rainy days it was quite impossible to read signals at this speed, unless of large dimensions or of very pronounced color. This suggests placing the signals in the car itself and operating them electrically, either by direct contact or through inductive means. Such a system was tried at Zossen and worked perfectly. An insulated piece of angle iron was placed alongside the rail, the rail constituting two poles of an electric circuit. As the car passed over contact was made with the angle iron by a brush which led current through a magnet in the car, thereby releasing a spring and allowing a disc to fall in front of the motorman, the circuit being completed through the wheel.

In the discussion Mr. F. J. Sprague said that taking into account all practical conditions a maximum speed of about 100 miles an hour is all we can reasonably try to reach, for a time at least. Mr. C. O. Mailloux said that when it comes to traveling over 50 miles an hour electrically some alternating-current system will probably be used. As to the future of electric traction, he considered that the substitution of steam traction will be by evolution rather than by revolution, and that there will still be steam locomotives 25 years hence. Mr. Sprague agreed with Mr. Mailloux in this latter statement, adding that we are not on the eve of a general conversion of steam-operated roads. Referring to trials of the 100-ton electric locomotive for the New York Central, he said that at first there was a distinct "nosing" caused by periodic lateral swaying. This, however, was made to disappear by using steel springs and friction plates to retard free action between the body of the locomotive and its pilot trucks. In many cases both direct and alternating-current motors are fitted for heavy electric traction, and which shall be the better for a specific case is a matter to be decided by local conditions. He considered that the multiplicity of conductors incident to the use of the three-phase system would stand as a bar to its general application to trunk line service. Mr. Shepard referred to a 135-ton, 1,600-hp electric locomotive which is being tested at East Pittsburg over a track four miles long. The overhead construction is of the catenary type, the voltage being 6,600 and controlled by an induction regulator. The results have been fully up to expectations. The tests showed that this type of locomotive will find its field in heavy service where concentrated power is required, as for instance on pusher grades where the electric locomotive has a particular advantage over the steam locomotive.

Electric Traction on Manhattan Island.

The growth of travel in New York City under the electrical regime is hardly realized, and the development of subways has but increased the facilities and the traffic at an accelerating pace. Mr. John B. McDonald, the New York Subway contractor, says that the three New York subways, each of the same capacity as the present, will be taxed to their capacity the day they are opened. He bases his belief on the theory that increased facilities produce increased business.

The growth of New York's transportation may be gathered from the following table, showing passengers carried by all lines in the city:

Year.	Passengers carried.	Year.	Passengers carried.
1865	79,618,818	1901	784,971,221
1875	165,737,079	1902	747,543,436
1885	297,032,303	1903	801,783,924
1895	463,959,663	1904	844,510,550

In 1904 the traction companies carried the equivalent of ten times the population of the United States. Owing to the liberal transfer system on the surface lines, and the expresses on the subway and elevated, the average length of journey is, it is said, far beyond anything afforded elsewhere in the world.

CURRENT NEWS AND NOTES.

WIRELESS ALL THE WAY.—The Cunarder *Campania,* on her last trip, was in wireless touch with the land all the way across, and had dispatches from the Marconi station at Poldhu when more than 1,700 nautical miles away.

REACHING OUT FOR YAP.—The Dutch East Indies and the Caroline Islands have been brought into direct cable communication with the United States through an extension of the Pacific Commercial Cable Company's line from Guam to Yap, in the Caroline group, and the Celebes Island.

LARGE PITCHBLENDE DEPOSIT.—A special dispatch from Denver, Colo., says that what is regarded as the richest known deposit of pitchblende, from which radium is obtained, has been discovered in Colorado. L. G. Nesmith, a mine worker, is the owner. The value of the pitchblende is $2 a pound. Up to this time pitchblende has been found in crevices in rocks, scarcely thicker than a knifeblade, but Mr. Nesmith has followed his vein until he has found a large body of the ore. During a recent visit to Denver he exhibited a piece said to be the largest in the world. He has made one shipment to Germany and will soon go there with a large supply.

ELECTRICAL PRIZES.—Under date of April 20, 1905, United States Consul-General Richard Guenther, of Frankfort, Germany, states that the Associazione degli Industriali d'Italia, No. 61 Foro Bonaparte, Milan, Italy, invites inventors to compete for two prizes offered by it, as follows: First prize, $1,600 and a gold medal, for a new method to prevent danger which may arise from the contact of high-tension with low-tension windings at electric rotary-current transformers; second prize, $100 and a gold medal for a simple, strong and reliable safety device for stopping cars running on an inclined plane in case of the breaking of the wire cable. The device must be capable of adjustment to ordinary cable roads now in use.

PARIS-ROME TELEPHONE.—A cable dispatch from Rome on May 26 says: "In a few weeks the French and Italian capitals will be directly united by telephone. After many failures the problem of the connection has now been solved. Angelini, chief of the Italian telegraph department, rang up Gaston Calmette, editor of the Paris *Figaro,* honoring him with the first direct talk over the wire and sending him a fraternal message from the Italian press. After an exchange of compliments Angelini invited the Parisians to listen to some Italian music. He then adjusted a phonograph to the telephone and the music of 'Traviata,' played in Rome, was heard with the greatest distinctness in Paris."

NATIONAL ELECTRICAL TRADES ASSOCIATION.—The annual meeting of the National Electrical Trades Association will be held this year on June 23 at La Corona Hotel, Montreal, and will be attended by many of the representative credit men of the electrical manufacturing and jobbing trade in the United States as well as Canada. Discussion will be participated in by members from Boston, New York, Philadelphia, Chicago and San Francisco. The National Association has grown to a membership of over 300, and the scope of its work is international in character, covering Canada and Mexico as well as the United States. Our Canadian cousins are making preparation for the meeting, which will end with a dinner and with toasts responded to by the leaders in the trade in the Dominion as well as from the States.

THE AUTOMOBILE CLUB OF AMERICA will hold its sixth annual show of automobiles and accessories in New York in January, 1906, open to all domestic and foreign manufacturers of automobiles, parts and accessories. The show will be held in the Armory of the Sixty-ninth Regiment, Twenty-fifth and Twenty-sixth Streets and Lexington Avenue, New York City. This is probably the finest exhibition hall of its kind in the world; it will be newly constructed, being finished shortly before the show, and will prove in itself an interesting feature. The occasion of the show will probably be the first opportunity afforded the public to inspect the Armory. One of the prominent and interesting features of the show will be the special exhibits of the club which will be gathered from all over the world, including the various types of motor cars used for military purposes, famous racing cars and other exhibits demonstrating the different fields of usefulness and adaptability of the motor car.

ELECTRICITY FOR MICHIGAN TUNNEL.—Within a short time—this summer—work on the Michigan Central tunnel under the Detroit River connecting the Canada division of the road with the Michigan division will begin. It will be one of the largest engineering enterprises ever undertaken in that part of the country. The cost is estimated at $7,500,000, and two and one-half years will be required to do the work. The length is two miles. Electric locomotives will be used exclusively.

NATIONAL VOICE RECORD LIBRARY.—The managing committee of the British Museum have established what is to be known as the National Voice Record Library. It has been agreed that prominent phonograph record manufacturers shall make permanent records or moulds, from which to make records of voices of leading men and women. These records or moulds are to be placed in the archives of the British Museum for the benefit of the public and future generations. Some scheme or method of exhibition is to be devised for visitors to the Museum.

RAPID TRANSIT ROUTES.—The New York rapid transit situation seems involved, but the Rapid Transit Commission approved the Brooklyn and New York routes known as Nos. 8, 9, 10 and the Manhattan Bridge route. The Brooklyn Transportation Reform League offered a plan for a "through" system from Park Row across Brooklyn Bridge, through Fulton, Adams and Myrtle Streets. The promoters of this scheme say that it has the advantage of doing away with large and expensive terminals. The cost is computed to be only $500,000, and the time necessary for its completion will extend over a period not greater than six months.

MR. EDISON'S WATCH.—An article in the *World's Work* for June on Mr. Edison says: "To Mr. Edison time is so valuable that he does not waste it even by taking account of it. Time to him is only the chance to get things done; and no matter how long it takes, they must be got done. In his office safe there is carefully locked away a $2,700 Swiss watch, given him by a European scientific society. It is never used. He buys a stem-winder costing a dollar and a half, breaks the chain ring off, squirts oil under the cap of the stem, thrusts it into his trousers pocket—and never looks at it. When it gets too clogged with dirt to run he lays it on a laboratory table, hits it with a hammer and buys another."

PURDUE UNIVERSITY.—In a well-illustrated pamphlet recently issued is contained much information concerning the building now occupied by the Department of Physics at Purdue University, for the erection and equipment of which the Legislature of the State of Indiana appropriated $60,000 in 1903. The first floor is devoted to general laboratory work, the basement to special work requiring greater isolation and freedom from mechanical disturbance, while the second floor is devoted to lectures and recitations. The laboratory of general physics is equipped for handling sections of 64 students, and the laboratory of electrical measurements is equipped for 32 students. The main lecture room has a seating capacity of 300. The three laboratory rooms in the basement have been set apart for magnetic measurements, electrochemical experiments and special research work.

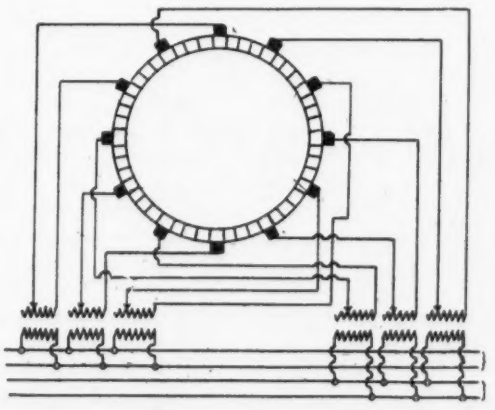
NEW YORK LIGHTING PLANT.—Contracts have been signed for the purchase by New York City of a site for its proposed electric lighting plant. The entire block bounded by Avenue A and East River, Ninetieth and Ninety-first Streets, has been selected. Fifty-three city lots are included in the block and it has a 205-ft. frontage on the river, with a depth of 650 ft. The site chosen is near other large electric plants and is conveniently located for economical operation, especially the landing of fuel and supplies. The land at present is vacant and is owned by the firm of Lesher, Whitman & Co. It has agreed to sell to the city for $350,000. By closing the deal at private contract all the delays and expenses of condemnation proceedings will be saved. It will be remembered that land for the municipal plant was to cost nothing, because the city had acres of just the kind of land wanted, "costing nothing."

ITALIAN SUBMARINE BOAT.—The Italian engineer Querrolli has invented a submarine boat something like the Lake, not intended for war purposes, but for picking up articles from the bottom of the sea. To this end it is provided with strong grappling hooks which are moved by electrical power. It was recently tested at Genoa. The greatest depth yet reached by the boat was 348 ft., and the crew did not experience any difficulty in breathing at this depth.

TO CONVERT CONEY.—It is stated that Scriptural texts, flashed from electric lights upon a high tower, will be a new form of evangelical work at Coney Island. Arrangements are now being made for the erection of a tower 125 ft. high there. The Rev. W. D. Hughes, pastor of the Coney Island Church, and superintendent of the Coney Island Rescue Home, is to build the tower, and will place upon the top the words, "Jesus saves," which will be visible from the four sides—north, east, south and west—lighted by electric lamps. Mr. Hughes insists that through the uplifting of the name of Jesus, Coney Island's purification will certainly take place. It is asking a good deal of electricity.

PNEUMATIC DISPATCH FOR LONDON.—Note was made recently in these columns of the intention to establish a pneumatic dispatch system in London. We now observe that a select committee of the House of Commons has begun the consideration of the Metropolitan Pneumatic Dispatch bill. The bill is opposed by the London County Council, a number of borough councils and electric supply and railway companies. Mr. Balfour Browne, K. C., explained the bill to the committee at the first hearing. He said the promoters proposed to establish a system of pneumatic transport within the administrative County of London, for the dispatch of parcels, goods and messages. The scheme was to lay down 95 miles of double 12-in. tubes, with 172 stations. The system, by which parcels were conveyed, was known as the Batcheller system, and had been successfully worked in America for the last twelve years. It was protected by eleven separate patents, all of which had been purchased for the purpose of the scheme now before the committee. The system was operated by electric power. That electric power was conducted to various motors at the several stations where the electricity operated air compressors. The parcels would be sent through the tubes by means of compressed air, and would be enclosed in carriers or shells. In order to carry out such a scheme there must be a considerable number of great people behind it, and this bill was promoted by a financial group. Among them were Messrs. Barclay and Bevan (of Barclay, Bevan & Co., bankers); Smith's Union Bank, Mr. Parr (of Parr's Bank); Mr. Hoare (of the Bank of England); Mr. J. Pierpont Morgan and a great number of others. The capital of the company would be four millions sterling.

ALTERNATING-CURRENT COMMUTATOR MACHINE.—In order to improve the commutation of the machine of the type indicated above, G. Winter and F. Eichberg, according to a patent issued May 23, propose to use a multipolar machine and to employ two sets of equipotential brushes distributed around the commutator, each brush of one set being connected with a brush of the other set, so as to form a plurality of independently-connected pairs.



From the accompanying illustration, which shows the invention applied to a six-pole, two-phase armature, it will be seen that all the brushes are connected in independent pairs, no connection existing between equipotential brushes, except through the armature winding. The inventors state that no short-circuits can be produced. No information is given as to the type of field winding used or as to the disposition of the armature coils. It is, therefore, not apparent why the short-circuiting of the coil under the brush is avoided when the armature is stationary.

MORE WIRELESS TORPEDOES.—A cable dispatch from Madrid of May 20 says: "Dispatches from Puerto de Santa Maria (on the Bay of Cadiz) announce that experiments made there with an invention of Senor Balsera, an employe of the Telegraph Department, for directing torpedoes at sea by means of Hertzian waves, have proved highly successful."

VARIABLE-SPEED, DIRECT-CURRENT MOTOR.—In a patent issued May 23 to Mr. A. F. Hemingway, there is revealed a type of construction for the field frame of a direct-current motor by means of which, according to the claims of the inventor, a speed ratio of 8 to 1 may be obtained without encountering commutating difficulties which would prevent the use of enough current to maintain the full rated power at all times. The motor is provided with three distinct sets of field poles, which may be designated as the main poles, the auxiliary poles and the commutating poles. The commutating poles are placed between the main poles and are wound with coils which are connected in series with the armature. The auxiliary poles serve for varying the effective field strength. The current through the windings on these poles may be given any value, so that the field due thereto may act with or against the field due to the main poles, which is of constant strength. The main poles and the auxiliary poles are mechanically distinct, but they are placed in longitudinal alignment, so that the magnetism in each is equally effective in producing counter e.m.f's at the brushes.

PORTLAND ENGINEERING CONGRESS.—An engineering congress will be held at the Lewis and Clark Centennial Exposition, at Portland, Ore., on June 29, 30 and July 1, 1905, to which all engineers, architects and other technical men are especially invited. A number of papers to be read at the congress have been promised by members of the Pacific Northwest Society of Engineers, the Technical Society of the Pacific Coast, officers of the United States Engineer Corps and engineers in the Reclamation Service of the Government. These papers are on a variety of engineering subjects of interest to Western engineers, and include such timely subjects as irrigation, hydro-electric plants and river and harbor improvement. A definite list of titles and authors will be issued in a later circular. The programme as now planned includes meetings on Thursday and Friday, June 29 and 30; an excursion to The Dalles of the Columbia and the Cascade Locks on Saturday, July 1, under the auspices of the Government engineers in charge of the Columbia River improvement. An excursion is also planned to Cazadero, where a large dam and hydro-electric plant are being installed by the Oregon Water Power & Railway Company. The secretary is Mr. Milnor Roberts, Pacific Northwest Society of Engineers, University Station, Seattle, Wash.

NERNST LAMPS.—On May 23 there was issued a budget of four patents to as many different inventors, the common object being improvements in the Nernst lamp. A patent of Mr. H. N. Potter, for which the application was filed August 14, 1899, deals with the ballast resistance and the cut-out mechanism. The ballast wire and the automatic cut-out are placed in a sealed chamber, which is provided with terminal connections similar to those now employed with commercial incandescent lamps. This chamber is arranged so as to be inserted between the lamp socket and the part of the lamp structure which contains the heater and glower. In distinction to the present electromagnetic cut-out devices, the cut-out mechanism is thermomechanical in its action, the expansion of the iron ballast wire, due to the heating effect of the current, allowing a retractile spring to open the circuit to the heater after the glower becomes a conductor. In an application filed July 14, 1900, Mr. M. W. Hanks proposed to utilize the heater as a ballast, the cut-out device being electromagnetically operated. On November 9, 1900, Mr. A. J. Wurts filed an application for a patent covering the use of a resistance in shunt to each multiple glower lamp when several are connected in series. The current through the shunt resistance increases when one of the glowers of the lamp burns out, and at its increased value it is able to operate electromagnetically a switch which cuts the lamp out of circuit either by simply opening the lamp circuit or by placing a suitable auxiliary shunt circuit around the lamp. The fourth patent, which was issued to Mr. E. Bennett on an application filed September 26, 1903, relates to details of construction, the glower, heater and non-conducting support therefor being combined in a single structure, which may be readily inserted in position in the lamp and readily removed when desired. These patents have been assigned to Mr. George Westinghouse.

Electrical Engineers of the Times.—XII.

HENRY H. HUMPHREY.

Mr. Henry H. Humphrey was born June 23, 1862, at Coolville, Ohio, and was graduated from Ohio University, Athens, Ohio, in 1884 with the degree of A.B. The following year he took up post-graduate work at Cornell in electrical engineering, receiving, in 1886, the degree of M.S. The summer vacations of 1884 and 1885 were spent on United States Coast and Geodetic Survey work in Southern Ohio.

In 1886 and part of the following year Mr. Humphrey was on the staff of Westinghouse, Church, Kerr & Co. as constructing engineer, during which service he was assistant engineer in connection with the installation of the alternating-current central station at Carbondale, Pa., the second alternating-current central station plant started in this country, and took part in erecting the experimental plant for the Hoosac Tunnel at North Adams, Mass. In 1888 he became superintendent of the Buffalo Light & Power Company, Buffalo, N. Y., and later superintendent of the Brush Electric Light Company of the same place. Resigning from the latter position in 1900 on account of a breakdown in health, he engaged in the engineering and contracting business in Omaha for about a year.

H. H. HUMPHREY.

During 1891 he was the agent of the Edison General Electric Company at St. Louis, and St. Louis manager for the same company during the year 1892. In 1893 as engineer and salesman of the St. Louis Electrical Supply Company, Mr. Humphrey had charge at the Chicago World's Fair of the installation of all the electrical work on the "Midway." In 1894 and 1895 he was engineer and sales agent for the Laclede Power Company, of St. Louis, and from 1896 to 1900 was engaged in consulting work as a member of the firm of Bryan & Humphrey. During this latter period the most important work was the construction of the plant of the Imperial Electric Light, Heat & Power Company, of St. Louis, all the electrical work being under his direct charge.

From 1900 to the present time Mr. Humphrey has been engaged in general consulting electrical and mechanical engineering work on his own account, confining his attention more particularly to isolated plant work in office buildings, factories, hotels, etc. Among other work along these lines was the design of a complete electrical plant for the De Beers Explosive Works at Capetown, South Africa.

Mr. Humphrey has contributed papers to the *Proceedings* of the Engineers' Club of St. Louis as follows: "The Design and Construction of Modern Central Lighting Stations" (1899); "Street Lighting of Cities" (1900); "Notes on Use of Beaumont Oil for Fuel" (1902). He is vice-president and manager of the Jefferson City Light, Heat & Power Company, of Jefferson City, Mo., and a member of the American Institute of Electrical Engineers and the St. Louis Engineers' Club. As chairman of the local committee, Mr. Humphrey represented the Committee of Organization of the recent International Electrical Congress in perfecting local arrangements prior to and during the meeting at St. Louis of the Congress.

Central Station Development in Denver.

FIVE years ago a representative of THE ELECTRICAL WORLD AND ENGINEER visited Denver. He found at that time that the Denver Gas & Electric Company was far from being in an enviable situation. Every one in the city, outside the company, seemed to be ready to metaphorically "throw a brick" at the company each time a good opportunity offered. No one had a good word for it or its service. It had just lost the contract for lighting the city streets, and a new company called the Lacombe Electric Company had secured the contract and was building a new station from which to do the city lighting and incidentally to engage in commercial lighting. This latter company had a contract with the city which provided for the expenditure of a certain amount in the construction of a plant which the city would have the power to purchase at the end of any year by paying the original price less certain amount allowed for depreciation of the plant. Shortly after this the Denver & Electric Company went into receiver's hands. Fortunately for it and for the electric lighting and gas business in Denver, that receiver was Mr. Henry L. Doherty. Some of the work that has been done in the past few years in converting the Denver Gas & Electric Company from a bankrupt into a prosperous concern has been described by Mr. Doherty and members of his staff at the meetings of the National Electric Light Association. A general review of the situation and of the work done, however, will be of interest at this time.

The situation five years ago in Denver was such as to call for something more than simply improvement in the physical condition of the plant and reduction in cost of production. Such a policy alone would never have saved the day. To be sure, plenty of good engineering was applied to the plant, but the changes were not of the sweeping and radical kind that one is accustomed to expect when new financial interests take charge of property of this kind. Stated briefly, what the management did was this: It went diligently and systematically to work to secure new business, having first analysed the cost of production and revised the rates so as to make it possible to secure new business on terms profitable to the company. Along with the rapid enlargement of the plant which this policy made necessary, improvements were made in the distribution system which cut down many of the losses and permitted more reliable service to be given. The old power stations were continued in operation, with some changes, and as the load grew, additions were made to enable the company to carry the greater part of its load more economically, leaving the older and less economical apparatus for service during the brief period of the winter-peak load. A review of the Denver Central Station situation therefore naturally can best be made under three heads:

(a) Adjustment of rates and analysis of costs.

(b) The getting of new business based on these rates.

(c) The work of the engineering department in overhauling the distribution system and establishing economical and reliable service.

Current was formerly sold in Denver on a straight meter rate, which, while favorable to the small and unprofitable consumers, such as residences, was not at all favorable to keeping out isolated plants and serving large consumers at attractive figures. What is now commonly known as the Doherty rate was put in force. The Doherty rate or "readiness-to-serve" method of charging was outlined first by Henry L. Doherty in a paper read before the National Electric Light Association at Chicago in 1900. It was further discussed by the same writer at the 1902 Convention of the same association and in a paper on rates before the Northwestern Electrical Association in January, 1901. It is, therefore, unnecessary to go elaborately into the reasons for or method of arriving at this rate. In Denver it is known as the "readiness-to-serve" contract. The amount charged a customer for "readiness to serve" is estimated by the company from its books, and depends on, first, the number of customers; second, the number of meters, and third, the maximum current demanded. There are certain fixed charges, such as cost of clerical labor, the cost of reading meters, etc., that are divided among the customers equally without regard to their current consumption. There are other charges which are dependent upon the maximum demand of the customer, such as interest on investment in distribution system, transformers, pole line and power house. These charges should evidently be apportioned among customers according to their maximum demands. The book-keeping methods of the company were described by F. W. Frueauff, general manager of the company, at the 1904 N. E. L. A. Convention, in a paper on office methods and accounting.

The "readiness-to-serve" contract of the Denver Gas & Electric Company calls for a payment of $12 fixed charge per year per consumer, plus $1.80 fixed charge for each 16 candle-power lamp connected. In addition to these amounts, which together constitute the "readiness-to-serve" charge, the customer pays for power consumed at the rate of 5 cents per kw-hour. One-twelfth of the yearly "readiness-to-serve" charge is paid each month. A discount of 10 per cent is allowed on all bills paid within 10 days from the date of bill. In figuring the number of 16 candle-power lamps connected, the following rules are used: Three 4-cp lamps equal one 16-cp lamp. Three 8-cp lamps equal two 16-cp lamps. Two 25-cp lamps equal three 16-cp lamps. One 50-cp lamp equals three 16-cp lamps. One alternating arc lamp equals 13 16-cp lamps. On special apparatus using alternating current, such as electric heating devices, the "readiness-to-serve" charge is based on the watts consumed reduced to the equivalent of 50-watt, 16-cp lamps. A charge of 75 cents per month rental is made on all incandescent arc lamps to cover trimming and maintenance. An installation charge of $4 is made on all incandescent arc lamps installed. Incandescent lamp renewals are made free by uniformed employes, who visit the premises of customers at regular intervals.

The "readiness-to-serve" contract is not universal by any means. Customers are given the choice between this kind of contract and one in which a charge of 10 cents per kw-hour is made for all current used, provided the minimum bill is not less than 5 cents per month per socket connected. A discount of 10 per cent for prompt payment is also made under this contract. Contracts for power are also made on both systems.

The "readiness-to-serve" power contract calls for a charge of $12 per year per consumer, plus $24 per year per connected hp as a fixed charge. The current used is then charged at the rate of 3 cents per kw-hour, other conditions being the same as for a lighting contract. The customer is given the option between this and a contract under which he must pay 4 cents per kw-hour for all power used, provided the minimum bill shall not be less than $1.50 per month nor less than $1 per month per hp connection. The power is supplied from separate circuits and generators. The power business is 440 volt, direct current, while the lighting business is alternating current. As can well be imagined, the "readiness-to-serve" contract is adopted only by those using current a large number of hours per day, while those having a large amount of apparatus connected and a small total consumption of current prefer to remain on the older contract. The adoption of the "readiness-to-serve" contract in Denver has therefore not had the effect of bringing in greater revenue from the most unprofitable class of consumers. This would have been the case, of course, had the rate been made universal and a "readiness-to-serve" contract required of all consumers. The object in the adoption of this rate, however, was not so much to bring up the revenue from unprofitable classes of consumers, as to make it possible for the company to reduce its rates to the most desirable and profitable consumers and to get new business where new business could never have been obtained under the older form of meter contract. The company now has about 34 per cent of its consumers on the "readiness-to-serve" contract, but the sales under the "readiness-to-serve" contracts amount to about 76 per cent of the total, so it is seen that customers who are being served under the Doherty "readiness-to-serve" contract are the largest, both individually and collectively, that the company has.

The incandescent lamp load connected is now the equivalent of 281,066 incandescent lamps. In this is included 822 alternating arc lamps on incandescent circuits. The direct-current power circuits have 5,726 hp in motors connected. There are 1,117 series direct-current arcs. Of the company's peak-load capacity, 69.8 per cent is alternating current, 23.3 per cent direct-current power, and 6.9 per cent series arc.

NEW BUSINESS DEPARTMENT.

Undoubtedly the most remarkable thing in the Denver Gas & Electric Company's organization is the business-getting department. When the present management took hold of the company, it was shrewd enough to see that the financial future of the company must depend mainly on the amount of new business that could be obtained, rather than on possible economies in operation, and that money spent in getting new business would yield a much larger return than an equivalent amount spent in making changes which would

reduce operating expenses, although to be sure, the latter changes were not neglected, as can be learned later in this article. The new business and advertising departments being treated elsewhere in this issue, in the article by Mr. John Craig Hammond, it will only be necessary to outline briefly the way the work is carried on by these departments. This company has probably carried on the most active campaign for new business ever undertaken by any company. The results have been very gratifying, both as regards the growth of business and the cost of getting the new business. For every dollar spent in getting new business, about $5 in gross revenue is obtained from the new business the first year of its connection. This includes both gas and electric departments, which are worked by the same soliciting and advertising force. If the electric department could be separated, it would show better than this.

Altogether, about 40 solicitors are kept working in various parts of the city outside of the main office, and four men in addition to this are kept on the floor in the main office to explain gas and electric appliances to customers and to solicit new business. The city is divided into 14 districts. Each district consists partly of business and partly of residential territory. Each district has assigned to it one representative and one assistant. The representative is responsible for his district, and his assistant, who is usually a new man learning the business, works under his direction. Besides these representatives, there are on the soliciting force two special-

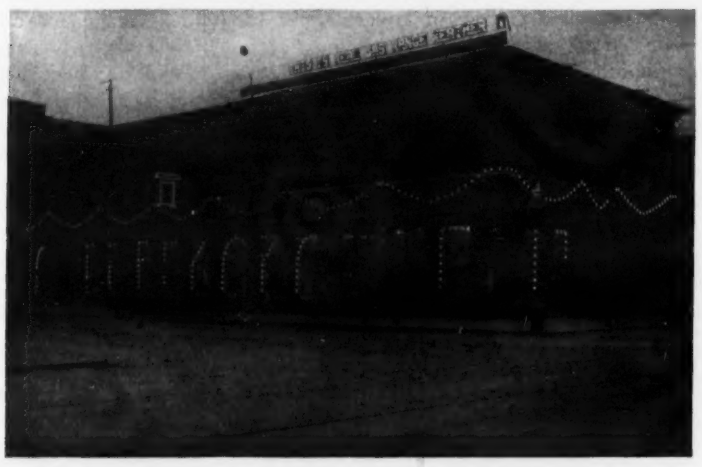


FIG. 1.—DENVER GAS & ELECTRIC COMPANY'S OFFICES AT NIGHT.

ists in electric power to help the solicitors in various districts to secure contracts. These specialists, who are men better acquainted with the engineering features than the regular solicitors, being in a position to know about the electric power work over the entire city, are of great help in figuring on new power contracts. There are also two specialists on electric signs, the company having given a great deal of attention to the electric-sign business in the past two years. Two specialists are kept at work on industrial fuel gas customers. Besides these six specialists, one man is assigned to new buildings and one to extensions of lines or gas mains. There are also a few apprentices in the new business department. The solicitors in the new business department are paid partly by a fixed salary and partly by commission on new business secured. A peculiar and elaborate system of figuring commissions is in use. New business secured is classified according to its relative value to the company. Thus a certain amount of new business, which from its nature is easy to get or would come to the company any way, figures much lower than business difficult to get. The cost to the company of making extensions for new service is also taken into consideration. New business which calls for short extensions of electric or gas mains is rated higher than business calling for extra investments in these items.

Every morning from 8.15 to 8.45, all the solicitors hold a meeting, which is presided over by Mr. C. N. Stannard, contracting agent of the company, who has charge of the soliciting force. At these meetings all sorts of matters pertaining to the getting of new business are talked over, so that the entire soliciting force is kept acquainted with what is being done, and the general policy of the company. The various solicitors report the more important new contracts secured and any new uses for electricity or gas they may have discovered. These meetings are a constant stimulus to the solicitors as well as an education.

The solicitors are furnished by the company with books giving the list of the possible specific uses, both for gas and electricity, by those engaged in various lines of business. The list is a surprisingly long one and is being added to constantly. It is valuable to the solicitors in suggesting to them where to look for possible new business when on the street. It is naturally impossible for a new

FIG. 2.—ELECTRIC SIGNS, DENVER.

solicitor to be acquainted with all the power and heat consuming devices used in various line of business, and these lists help them to get acquainted with the uses. The solicitors keep a list of possible new customers or old customers with whom there is some chance of doing additional business by introducing new appliances. These lists are sent at regular intervals to the advertising department, which sends circulars to these customers, thus aiding the solicitors. The lists are constantly being revised to prevent waste of postage and circular matter by the advertising department.

Every Tuesday evening a meeting is held by what is called the Commercial Council of the company. This consists of all employes and officers of the company who come in contact with the public. The new business department is in charge of Mr. Philip Cross.

The advertising department has charge of preparing and mailing of circular matter and also of advertisements appearing in the

FIG. 3.—ELECTRIC SIGN, DENVER.

local newspapers. The heads of this department keep in close touch with the daily papers, and by this acquaintance are of much service to the company. It is largely through the efforts of this department that the phrase "boost for the city of lights" has become so common in Denver. The department is in charge of Mr. John Craig Hammond, assisted by Frank C. Farrar.

OFFICES.

The fact that the company is leaving no stone unturned to bring this service before the Denver public is well shown by its offices, which occupy a two-story building at Seventeenth and Tremont Streets, opposite the Brown Palace Hotel. At these offices a large amount of show-window space is taken up with gas and electric appliances, and, as said before, four solicitors are kept constantly on duty during office hours to look after those who come in to look at new electric and gas appliances, or those who may stop to look at these appliances as they come to pay bills. In this way the interest of many persons in new current-consuming devices is attracted where otherwise they would never have thought of such things. The public is invited to make the offices a kind of general headquarters, to come in and wait for a street car, purchase postage stamps, get the services of a notary public and secure accommodation in many of the other little ways which have hertofore been monopolized by the corner drug store. The building is brilliantly lighted, both inside and out, at night, and an electric sign on top of the building is changed frequently, so that the public is kept guessing as to what is coming next.

A meeting of the office force is held every other Monday evening, to discuss office methods and other matters of interest.

ELECTRIC-SIGN BUSINESS.

It will probably surprise visitors to the Convention to learn that the extensive electric illuminated sign displays seen on the business

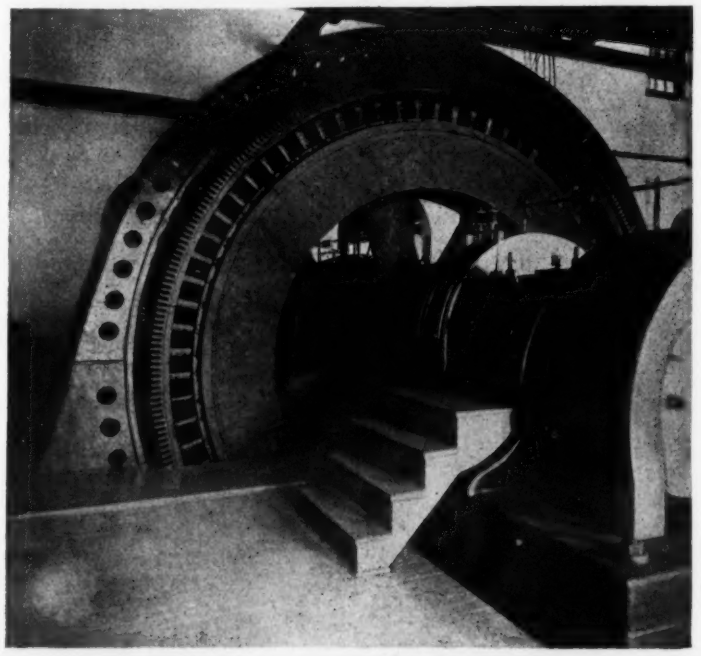


FIG. 4.—SIDE VIEW OF 1000-KW FLY-WHEEL TYPE ALTERNATOR.

streets of Denver at night are practically all the results of less than three years work. At the time the company began to push its sign business, in September, 1903, there were about 11 electric signs in use in Denver. There are now approximately 400. The rates on the electric sign business are based on the company's "readiness-to-serve" charge, plus a flat rate equal to the current consumption, as the signs are turned on and off at definite hours by the company's patrol men, and the current consumption is therefore known. Some very striking signs are now in use, and further surprises are promised by the time the Convention delegates arrive.

ENGINEERING FEATURES.

The Denver Gas & Electric Company generates three classes of current. Incandescent lighting is from single-phase distribution circuits supplied from 3-phase, 60-cycle, 2,400-volt generators. Nearly all the power business is carried on a three-wire, direct-current distribution system, having 440 volts between the outer mains and 220 volts between the neutral and outer mains. This is a continuation of an old 500-volt power circuit. The direct-current network for power now covers all the downtown business districts and manufacturing districts adjacent thereto. There is very little demand for power except in and near the business district, hence the 220-440 volt system answers the requirements very well. There are also some direct-current series arcs, as previously noted.

The company has two power stations. The principal one, capacity 6,000 kw, is known as the West Side Station, at Sixth and Lawrence Streets, and is located so as to obtain condensing water from a ditch. The other station, known as the East Side Station, capacity 2,000 kw, is about three blocks northeast of the Union Depot. Both stations are on railroads. The East Side Station, when in operation, obtains condensing water from a large cooling tower. The West Side Station is operated continuously. The steam plant in the East Side Station is operated only during hours of heaviest load.

The West Side Station was originally one of the old two-story type, with line shaft driven by Corliss engines and a lot of small dynamos on the second floor. It has gradually been worked over as extensions were made, so that but little line shaft remains. The greater part of the output is obtained from direct-connected and direct-belted apparatus. The newest end of the station contains two 1500-kw Bullock, three-phase generators, direct-connected to Filer & Stowell cross-compound condensing engines. This plant also has several Reynolds-Corliss engines belted to generators, two generators being belted to each engine. One of each such pair of generators is a direct-current power machine, and the other a 3-phase alternator for lighting, the idea being to have belted units which can supply both lighting and power service during light loads. In the East Side Station, the lighting load is carried principally by generators belted to Corliss engines. Part of the direct-current power load of the East Side Station is really supplied by the West Side Station over a 2400-volt transmission line in the following manner: A 450-kw alternating-current generator in the East Side Station is being utilized as a synchronous motor and belted to two direct-current generators, which supply the power service. The 2,400-volt, three-phase, alternating current for operating this synchronous motor is supplied from the West Side Station. The East Side Station, being much nearer the center of power than the West Side, the losses by this arrangement are considerably less than if the attempt was made to supply all of the direct current to the power net work from the West Side Station.

The work done under the present management in reducing distribution losses was described in a paper by Mr. C. W. Humphrey, chief engineer of the company, at the last National Electric Light Convention at Boston in 1904. Mr. Humphrey has a very complete system for determining all the losses which it is possible to determine, including primary-resistance losses, transformer-iron losses, transformer-copper losses, secondary-resistance losses, and meter-shunt losses. The primary resistance losses are determined by shutting down a feeder during light load and testing it by pulling the primary fuses on transformers between the station and the center of distribution, short circuiting the feeder at the center of distribution, and testing its resistance by direct current with the drop of potential method. Transformer-iron and copper losses may be made before the test transformer is put up or may be made after the transformer is in service, by opening its primary circuit and measuring the watts input with instruments connected between the transformer and the secondary mains, the secondary mains being kept alive by other transformers. Some remarkable results were secured in the cutting down of losses by changing from the 1000-volt system with small transformers to each customer to a 2,000-volt system supplying three-wire secondary networks through the medium of large transformers, each sufficient to supply a group of customers. As a result of this charge of one feeder, the ratio of power sold to power generated was raised from 40 per cent to 70 per cent. The lost and unaccounted-for current was reduced from 25 per cent of the output to 15 per cent of the output, leaving the known losses about 14 per cent of the output. Power generated and supplied to that feeder was doubled in six months, and the amount of power sold off of the feeder was approximately multiplied by 4. On another feeder the transformer-iron loss was reduced in six months from 30 per cent to 5.9 per cent of the total output. The greater part of the lost and unaccounted-for current was found to be due to thefts. Other losses were due to slow meters, leakage through grounds, and errors. A number of ampere-hour meters were in use which would not start on less than two to four 16-candle-power lamps. The replacing of these meters by induction type wattmeters, which would register on light loads, decreased the lost and unaccounted-for current, and, of course, the checking of meters and their re-calibration resulted in wiping out many of the losses due to slow meters.

One of the interesting things found during Mr. Humphrey's investigation of losses was that transformers which are supposed to be of the same voltage and output would not divide the load equally between them if placed close together on the same secondary network. Of course, as a matter of fact, transformers are seldom placed close together in this way except as a temporary experiment where a transformer of sufficiently large capacity does not happen to be available. In most cases transformers are placed far enough apart so that the unequal division of load is prevented by the resistance of the secondary mains, and the load of each transformer is dependent on the current consumption in its immediate vicinity.

All trouble from transformers burning out due to overload has been overcome by a systematic testing of the load each transformer is carrying during the peak period. In December when the loads are heaviest, some tests are made every night in the business district, and tests are made at least every Saturday night the year around. These tests are made with an instrument of Mr. Humphrey's design called a line meter. It is simply a series transformer with a ring-shaped core. This core can be opened so as to slip over one secondary lead of a transformer. On this hinged core is wound the secondary of the series transformer, which is connected to a portable instrument calibrated to show in amperes the current flowing in the circuit to be measured. By these tests, it is frequently found that a load is not evenly balanced between the two sides of a 3-wire secondary supplied by a transformer. One side may be much overloaded, and the other underloaded. In the last two years Mr. Humphrey says that the company has not lost a single transformer by overload, whereas, previous to the time that this systematic testing was made, there was much trouble from transformer burn-outs. The work of testing is done by two men, who can test a large number of transformers during the peak load in one evening. One of these carries up the series transformer and slips it over the secondary lead, while the other takes the reading on the portable instrument.

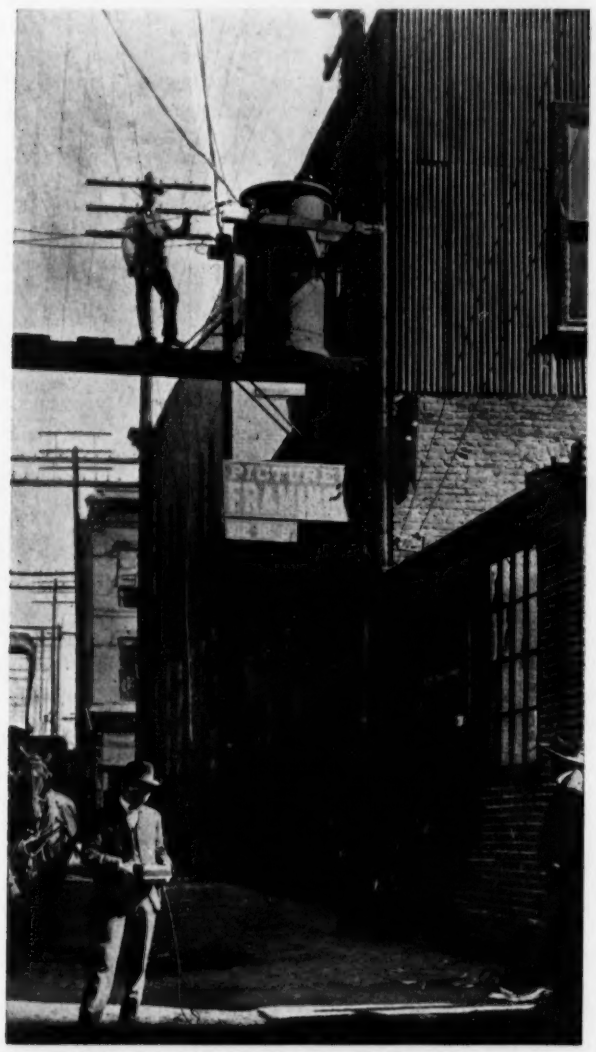


FIG. 5.—TESTING TRANSFORMER LOADS AND EXAMPLE OF ALLEY CONSTRUCTION, DENVER.

The standard sizes of transformers used are 5, 10 and 20 kw. The general scheme of secondary distribution is to have one transformer supplying a section of secondary mains. These various sections of secondary mains are connected together through fuses. Each transformer has primary fuses of the plug type. In case the primary fuses on a transformer blow out, the load on the secondary of the transformer must immediately be taken by transformers in adjacent sections, feeding through the fuses between sections. If the load is heavy enough so that there is danger of blowing the primary fuses of these adjacent transformers, it will blow the fuses between the secondary sections and so cut out the secondary section whose transformer is out of service. It is believed that it is much better to thus cut one section of the secondary network should its transformer fail during a heavy load than to attempt to keep it in service by overloading adjacent sections at the risk of blowing the fuses on all the transformers in a given secondary network, putting all that part of the city in darkness. Under the present arrangement, if one transformer fuse goes out, it causes a little inconvenience to a comparatively small number of customers, and the fact that the transformer is out of service is promptly known. At the same time, by tying together the sections, different transformers can be made to help each other to some extent and temporary loads at one point do not overload the nearest transformer as much as would be the case if it had to carry its section entirely alone.

The secondary fuses which are inserted in the line between sections of secondary mains are of a peculiar form. A circuit-breaking pin is used of the same type that has been employed for many years where service loops are to be taken off from series arc circuits. These circuit-breaking pins support two insulators a short distance apart. The ends of the adjacent secondary sections, being terminated on these insulators, the wire is bared near the insulator, and a fuse consisting of a piece of copper wire is wrapped around the secondary near the pin. The other end of the fuse is attached to the other secondary in like manner.

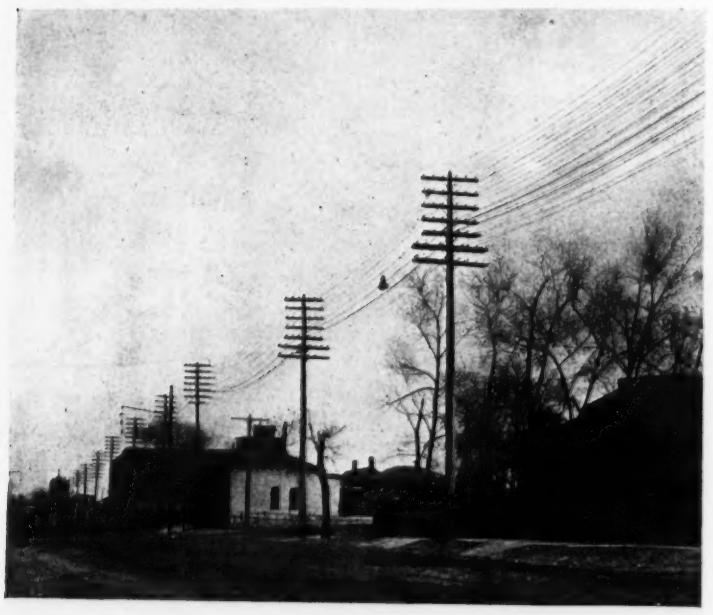


FIG. 6.—LINE WORK, DENVER.

In the primary circuits no fuses are used save those at each transformer. Neither feeder circuits nor generators are fused at the power station. It is believed that it is impossible for a short circuit to occur which would damage the alternating-current generating apparatus before the circuit could be opened by a switchboard attendant, and that fuses on generators or feeders would be more of a detriment than a benefit by opening the circuit unnecessarily.

On the company's distribution system, which is overhead, some fine examples of overhead line work are to be found, some of which are shown in the accompanying engravings. The business

part of the city is so arranged that it has not been found necessary to run any of the main feeder lines along the busiest streets. The main feeder lines skirt the business district, and at each alley branches are taken off to supply transformers in that alley. Almost all of the lines in the down town district are in alleys. In the business districts, the cross arms usually extend the full width of an alley and are supported at each end by poles placed each side of the alley. Transformers are either hung on the poles, or if very large, are placed on a bridge built between poles.

A transformer winding department is maintained at the East

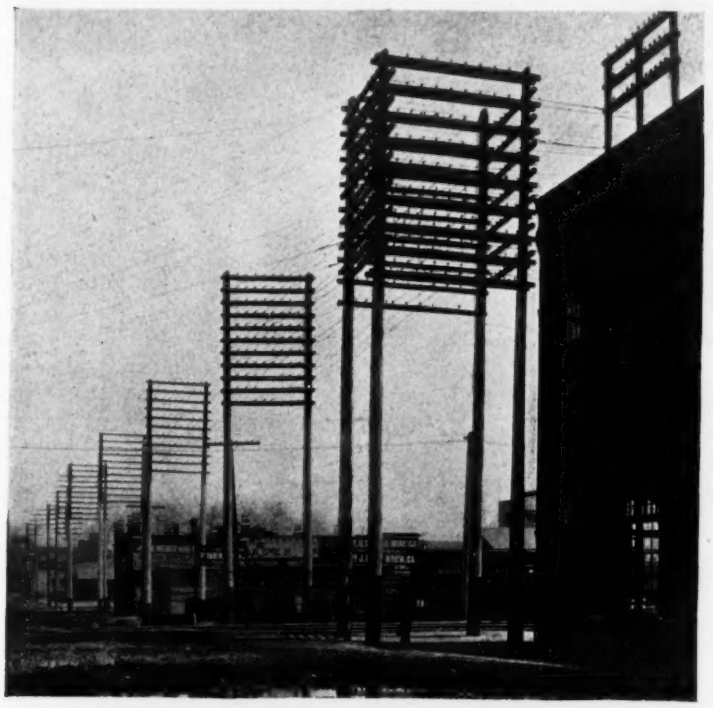


FIG. 7.—OVERHEAD WORK LEAVING WEST SIDE STATION, DENVER.

Side Station, where burned-out transformers are rewound. In the wiring room there is a coil-winding machine built by the company. This machine has proved extremely useful. It is operated by power from an electric motor overhead. The form on which the coil is wound can be revolved at the will of the operator by tightening the driving belt of the idler pulley by means of the foot lever. A ladder rack is provided for spools of wire so that a number of different sizes of wire can be kept on the rack at once, although only one is needed at any one time. The coils, when they are taken from the wooden form, are held together by soft copper strips which are placed in the form before winding begins. Oiled linen is placed between the layers of the coil as it is wound, with the additional protection of thin fiberoid under the ends where the tension is greatest. Between the coils are placed layers of fiberoid and oiled linen stuck together. Transformers are tested with 10,000 volts between the primary and the core before being put in service. They are also tested for copper and iron losses. All this testing is done in this transformer winding room, a bank of lamps and testing table being provided. The insulating material which goes into transformers is also tested before use.

TRANSMISSION TO GOLDEN AND THE GOLD DREDGES.

The company has a 11,000-volt, 3-phase transmission line running to Golden, a village situated at the entrance to Clear Creek Canon, at the foot of the mountains, 14 miles from Denver. The current is sold to a company in Golden, which retails it for lighting purposes at that place. About eleven miles from Denver, on the way to Golden, are two gold dredges for gold mining, which are supplied from the same transmission line. These dredges, when in operation, take about 150 kw each. Electrically-operated gold dredges have been in use in the river valleys in California for several years, but are a novelty in the vicinity of Denver. Although dredges have been built for operation by steam, the development of electric power transmission has given a great impetus to this method of mining, for the reason that the expense of operating steam dredges in most placer mining districts has been so high as to prevent their use in many places where they could be profitably operated if cheap electric power were available. The gold dredge is an enormous piece of apparatus designed to accomplish the excavation and washing of placer dirt which contains gold. Before the introduction of the gold dredge, it was possible to wash placer dirt for gold only where an abundant supply of water under a good head was available and where the location of the deposit was such that it could easily be washed either by large streams of water under high pressure, or, if this was not possible, where it was rich enough so that the miners could afford to shovel it into sluice boxes where it would be washed by a stream of running water. The gold dredge needs no great supply of water for its operation, as it usually makes it own pond as it goes along. It has an immense conveyer, which digs into the bank of the pond at one end and conveys the sand, rock and gravel to a point in the dredge where the boulders are separated from the finer material by revolving screens. The boulders are taken by another set of conveyors and discharged at the rear in an immense pile, as can be seen by the accompanying engraving. The finer material which contains the gold dust is delivered to washing and concentrating machinery, and after being washed, is discharged as tailings in the rear of the dredge. Every operation of the gold dredge is one calling for power. There are motors of large capacity for operating the buckets of the endless conveyor, which dig up the material in the first place. The revolving screens require a small amount of power, as do also the concentrating tables over which the material passes. These tables are given a constant shaking motion when in operation. The water for washing is supplied by electrically-operated pumps. Whenever it is desired to move the dredge, electrically-operated winches and

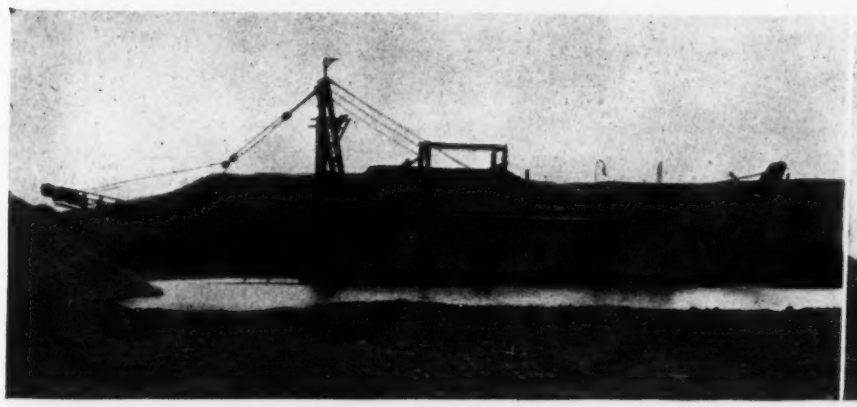


FIG. 8.—GOLD DREDGE.

FIG. 99.—PORTABLE SUBSTATION FOR DREDGE.

winding drums are brought in operation. The dredge usually works near some stream where it is only necessary to excavate a pond in order to float the dredge. After that the dredge eats its way in any desired direction, always keeping a sufficient pond to float it, because of the water that seeps through from the adjacent stream.

These two dredges are operated near Clear Creek. Owing to the fact that dredges are constantly changing location, it was necessary to provide a portable sub-station and also to provide flexible connection between the sub-station and the dredge. Two views of this sub-station are shown. It is a substantial little wooden building which can be pulled from one place to another by a team of

horses. The high tension lines enter at one end, as can be seen, and the low-tension cable leaves at the other. The sub-station contains simply three 500-kw oil-cooled transformers, with fuses and lightning arresters. These transformers step down from 1,100 to 390 volts, the secondary voltage being chosen with a view to operating a rotary converter on the dredge, which supplies current to series 500-volt motors operating the conveyor. The three secondary wires from the sub-station to the dredge are taken in a single 3-conductor cable containing three No. 000 wires, separately insulated with rubber, with several thicknesses of jute over all. For a part of the distance to the dredge, this cable has been pulled into a hose for protection from moisture.

At Golden, about 100 kw is supplied for local lighting. The voltage regulation at Golden is obtained by an automatic three-phase, General Electric induction regulator.

Electric Light and Power in Colorado Springs.

THE electric light and power service in Colorado Springs and neighboring towns is furnished by the Colorado Springs Electric Company. One of the first things of interest in connection with this company's work is the fact that most of the power was until recently generated in a large steam plant located some four miles from the center of Colorado Springs, being so located for the purpose of obtaining coal directly at the mine without steam railroad shipment. The location of power plants at coal mines and the transmission of power over high tension lines instead of the shipment of coal by rail has been frequently talked of but sel-

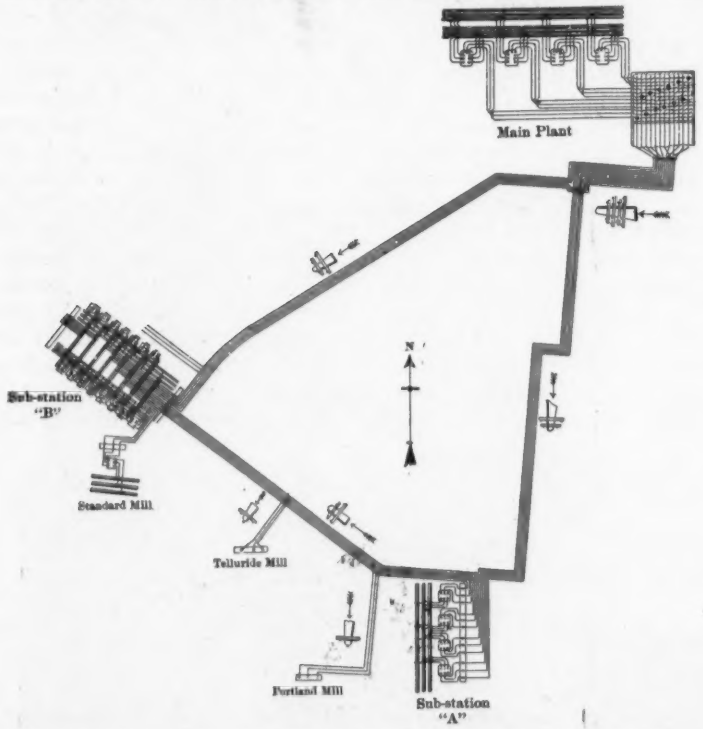


FIG. 1.—MAP OF TRANSMISSION SYSTEM OF THE COLORADO SPRINGS ELECTRIC COMPANY.

dom carried out, and the plant at Colorado Springs is one of the few examples of a power transmission plant located at a coal mine.

Another feature of interest in connection with this company is the fact that its present day load is carried almost entirely by power secured from the Pike's Peak Hydro-Electric Company, which has a water power plant near Manitou, operating under a 2,300 foot head of water. This is probably the highest head in use in any electric water power plant in the United States. At present writing a steady load is carried by the water power plant. It feeds into the Colorado Springs Electric Company's transmission system. The latter company's steam plant operates one unit, which is kept in running during light load for the sole purpose of taking the fluctuations in load that occur on the system and thus maintaining good voltage regulation. The fluctuations of load above a certain amount are taken by the steam plant because of the greater sensitiveness of the governors of the steam plant.

The transmission system of Colorado Springs Electric Company is interesting because it supplies so many different kinds of service and is arranged so as to prevent accidents to one of the transmission lines from interrupting the service.

The general plan of the transmission lines is shown in the accompanying drawing, Fig. 1. Sub-station A. is in an old steam plant in the heart of Colorado Springs. A part of this steam plant is operated part of the time because of some steam heating which was supplied from this point before the present main plant at the

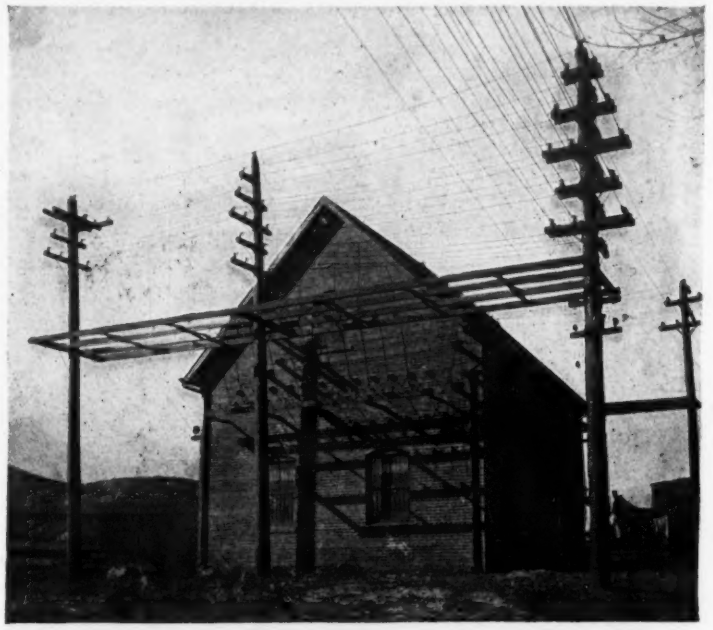


FIG. 2.—SUBSTATION B, COLORADO CITY, SHOWING LINES ENTERING.

coal mines was built. It was considered undesirable to discontinue this steam heating service as it has prevented several large consumers from installing isolated plants, as they would have done had it been necessary for them to put in boilers for heating. On the diagram of transmission circuits, Fig. 1, only the oil switches and bus-bars are indicated at the various stations. At the main plant, located at he northeast corner of the transmission system, there are two sets of bus-bars. Four three-phase, 6,600-volt transmission circuits leave this main plant. These four circuits are carried on one-pole line a short distance and then separated into two-pole lines, each carrying two circuits. One of these runs southwest directly to sub-station B., Fig. 2. This sub-station is in Colorado City, which adjoins Colorado Springs on the west, and is a town in which several ore reduction mills are located. The other pole line runs south into Colorado Springs, supplying sub-station A directly. Between sub-station A, in Colorado Springs, and sub-station B, in Colorado City, is a pole line carrying two three-phase transmission circuits. The transmission system, therefore, forms a triangle, and should an accident occur on any side of the triangle, service could be maintained through the other two sides. Sub-station A has one set of bus-bars, to which any of the four transmission lines entering this sub-station can be connected through an oil switch. Sub-station B, which is mainly a switching station, has a double set of bus-bars and each transmission line terminates in two oil switches, as indicated. Thus each transmission line entering sub-station B can be thrown on to either or both sets of bus-bars. One switch is provided for the purpose of connecting together the two sets of bus-bars. Two feeders enter this sub-station from the plant of the Pike's Peak Hydro-Electric Company, and each of these feeders terminates in two oil switches, just as do the other feeders entering the sub-station. The switchboard at sub-station B is shown in Fig. 3. Leaving the sub-station is one short feeder, supplying the Standard Mill. Tapped into one of the transmission lines between sub-stations A and B is the Telluride Mill, and off on the other transmission circuit on this side of the triangle the Portland Mill is operated. These mills are all engaged in reducing gold ore from the Cripple Creek district, which is located about forty miles by rail from Colorado City.

This system, although not as large as some of the great transmission networks on the Pacific Coast and in Utah, offers a chance

for studying on a small scale about all the conditions usually met with in a transmission plant supplied by different kinds of prime-movers and furnishing power for all kinds of service. All classes of service are supplied from the same bus-bars. In the mills the power required by some of the large motors varies considerably from one second to another, especially on motors operating ore-crushing machines. At Colorado Springs a synchronous motor drives a 500-volt, direct-current power generator, which furnishes the power service in the city of Colorado Springs. This synchronous motor is belted to a line shaft, from which shaft the power generators are also belted. During the heating season this line shaft is driven by a Corliss engine and the motor is used as a generator. In fact, it was always used as a generator before the station in Colorado Springs was turned into a sub-station.

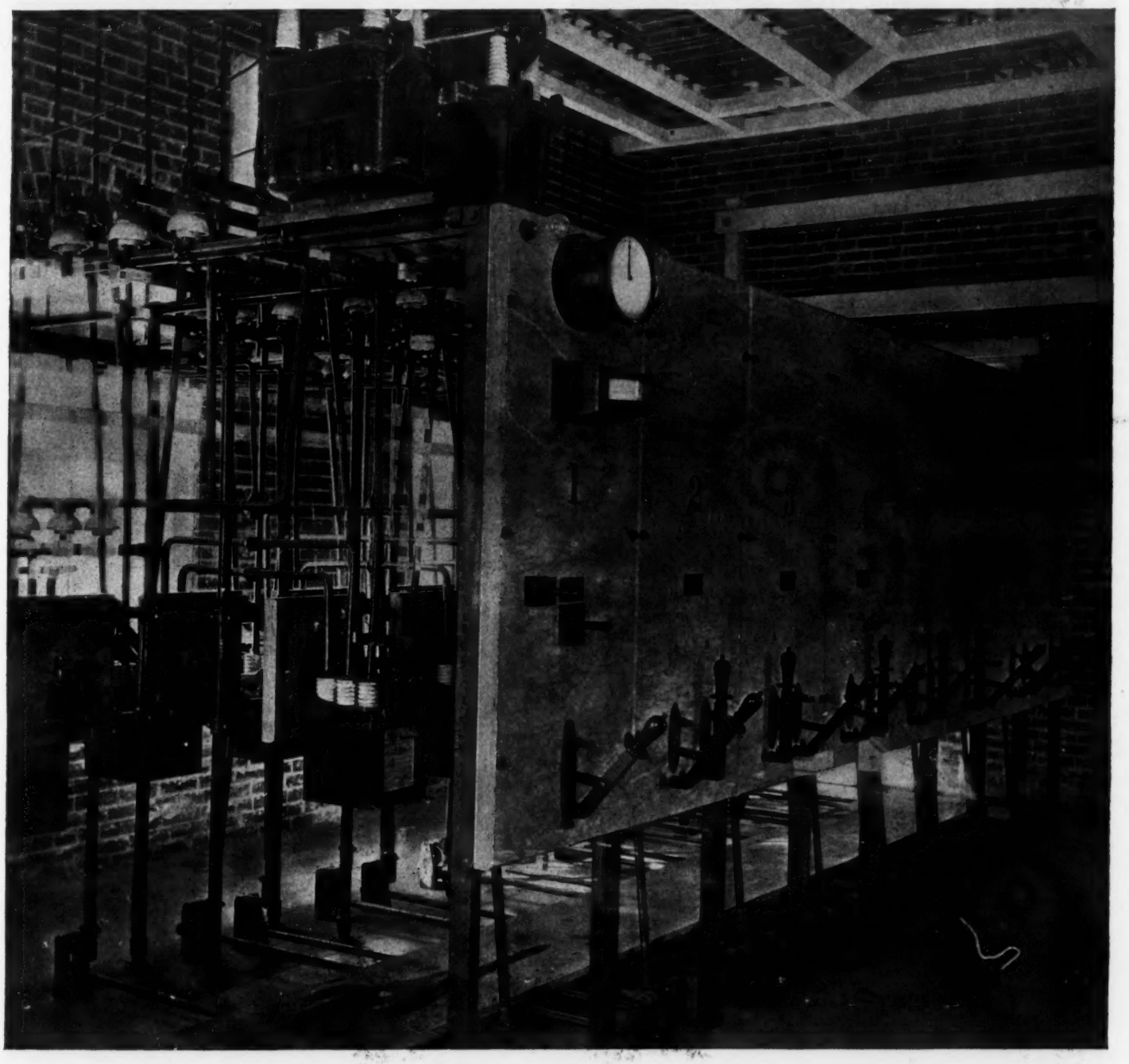


FIG. 3.—SWITCHBOARD AT SUB-STATION B, COLORADO SPRINGS.

At the mills a number of synchronous motors have been installed and by regulating the fields of these motors the lagging current caused by the induction motors can be to a large extent compensated for, so as to bring the power factor of the transmission lines somewhere near unity.

The main power plant at Austin's Bluff contains three generators, Fig. 4, each of 750 kw, generating three-phase current at 6,600 volts. Each generator is direct-connected to a cross-compound, 24 and 44 by 48-in. Corliss engine, built by the International Power Company. This station is non-condensing, as it was believed at the time the station was built that coal at the mine was too cheap to justify an investment in condensers. There are two 50-kw steam-driven exciters, consisting of General Electric generators driven by high-speed Ames engines. Excitation is ordinarily furnished in a peculiar manner. As stated before, this steam plant is now being operated during the middle of the day simply for the purpose of taking the momentary peaks of the load, the water power plant supplying most of the output. The low-pressure crank of one of the engines has been disconnected so that only the high-pressure cylinder is used. To aid in maintaining good voltage regulation a Tirrill type T. A. regulator of the General Electric Company was first placed in the fields of the exciter. As the fields of the exciter in this particular case had to be run at a high point of saturation, it was found that the rapid interruption of this field circuit by which the Tirrill regulator accomplishes its object caused severe arcing at the contact points of the regulator. The plan was, therefore, adopted of exciting the fields of the exciter from a small motor-generator which the company happened to have on hand and accomplishing the regulation by the interruption of the field circuit of the small generator; thus the exciter of the main generators in turn has an exciter, and the regulation is accomplished in the field of this exciter's exciter. The engine room is spanned with a 20-ton Maris

Brothers' traveling crane. In the boiler room are five Aultman & Taylor 400-hp boilers. All feed water passes through a Worthington watermeter.

FIG. 4.—INTERIOR OF COLORADO SPRINGS POWER PLANT AT COAL MINES.

Coal is obtained from a mine located in the rear of the power house at a distance of several hundred feet. There is a tram line between the coal mine and a small dumping shed near the power house. This tram is a cable line worked by gravity. The loaded car going down pulls an empty car up. At the dumping shed the coal cars are dumped and coal is conveyed into the power house by a home-made conveyor. A reserve supply of water is always furnished by reservoirs, from which the power house is supplied.

The coal obtained here is Colorado lignite, having a calorific value of about 10,000 British thermal units per pound. Before the greater part of the load was taken by the water power plant of the Pike's Peak Hydro-Electric Company. This steam plant when operating under the most economical conditions gave a kilowatt-hour at the switchboard for about seven pounds of this coal. The usual performance varied from seven to eight pounds per kilowatt-hour, the engines being run compound non-condensing. Coal at the plant costs in the neighborhood of 70 cents a ton. In Colorado Springs the cost is more than double this on acount of the transportation charges.

At sub-station A in Colorado Springs current for incandescent lighting is obtained by step-down transformers, reducing from 6,600 to 2,300 volts, three-phase. The lighting distribution system in Colorado Springs is 2,300-volt, single-phase. Street lighting is done with six 50-light, 6.6-amp., General Electric tub transformers. Besides this there is in this sub-station a 300-kw, three-phase, 2,300-volt Bullock generator, which, as before explained, is driven from a line shaft by a Corliss engine during the steam heating season. In the summer time it is supplied with power from the secondaries of the step-down transformers and runs as a motor to drive 500-volt, direct-current power generators, belted from the same line shaft. In the winter the apparatus on this line shaft is driven by the Corliss engine. There is one 150-kw, 500-volt, direct-current power generator and two of the same type, each of which has a rating of 75 kw. The engine is of the Corliss type having a rating of 600 hp.

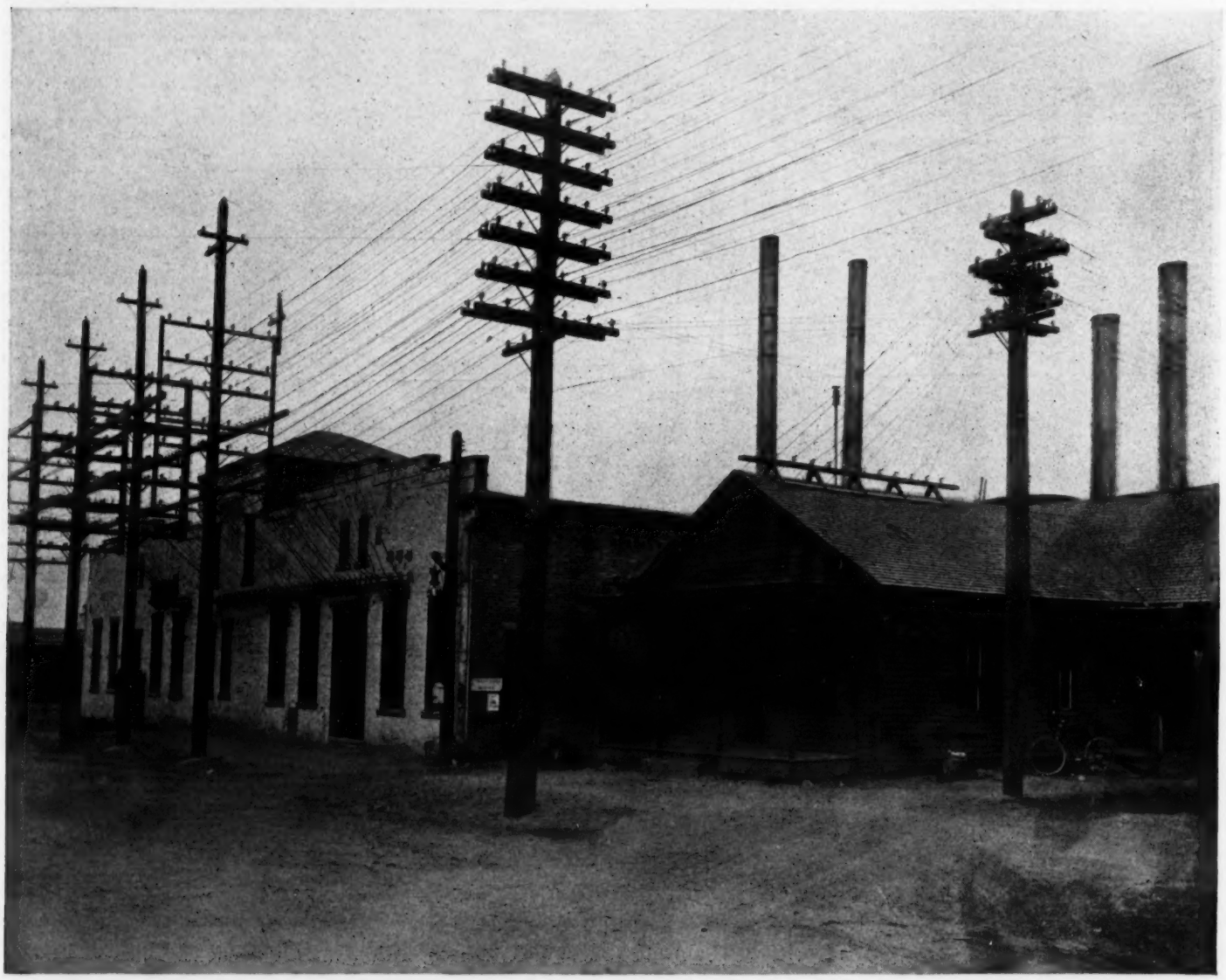


FIG. 5.—LINES LEAVING SUB-STATION A, COMBINED STEAM PLANT AND SUB-STATION IN COLORADO SPRINGS.

The Antlers' Hotel, the largest in the city, is supplied both with exhaust steam for heating and with live steam for cooking and

laundry purposes. Some laundries are also supplied with live steam. Of course, the principal object in giving this live steam service is to offer customers such service that they will not put in isolated plants.

An interesting piece of line construction is shown in one of the accompanying engravings (Fig. 5) where the lines entering and leaving the sub-station in Colorado Springs are shown. Although the structure is large, it has a much neater appearance than some of the more crowded terminal pole arrangements frequently seen.

The maximum load of the company in April last was about 2,200 kw and the minimum about 630. The average load for twenty-four hours is about 1,200 kw and the load factor is remarkably high, being over 50 per cent. This high load factor is due, of course, to the presence of the reduction mills, which run twenty-four hours a day. Of the total daily output about one-third was supplied by the main steam plant, two-thirds by the Pike's Peak Hydro-Electric Company and a very small percentage by the steam plant at sub-station A. The lighting business in Colorado Springs is peculiar on account of the large amount of residential lighting in proportion to the commercial lighting. Colorado Springs is known as a city of millionaires and is unique among American cities of its size because of the large amount of wealth concentrated there. This is due partly to the fact that many wealthy mine owners live in Colorado Springs and partly because other people of wealth of the East, who have been obliged to go to Colorado for their health, have settled in Colorado Springs. The residential lighting is, therefore, a much more profitable and important part of the total lighting than in most cities, because of the large number of inhabitants who are liberal in their demands for effective illumination.

Three-wire, secondary circuits, about one block long, each fed from a transformer, is the common method of distribution. These secondaries are not interconnected; 104-volt lamps are used.

The connected load includes the equivalent of 62,000 16-cp incandescent lamps, 137 alternating-current, constant-potential, alternating-current arcs, 552 kw in 500-volt, direct-current motors, 2,962 kw in alternating-current motors, and 259 alternating-current, 6.6 series arc lamps for street lighting. Colorado Springs and Colorado City together have about 35,000 population, so that the connected load

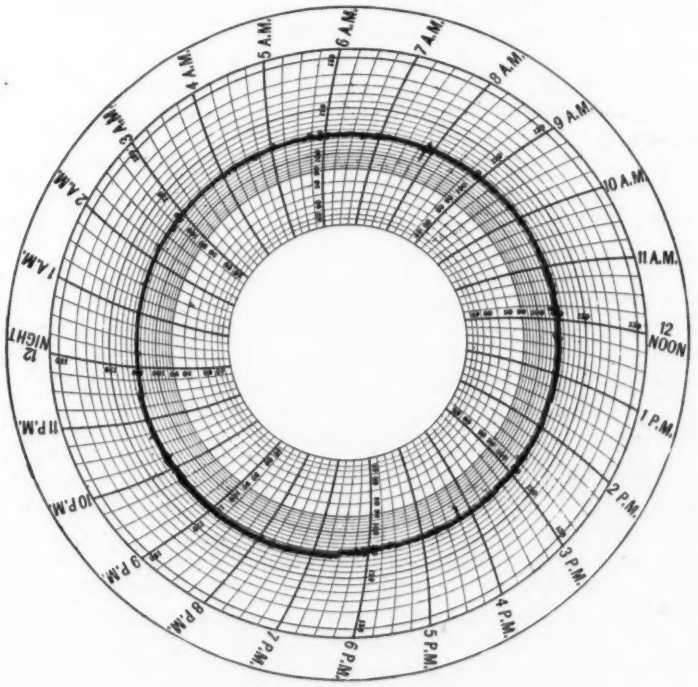


FIG. 6.—VOLTMETER CHART.

is high for the population served. These figures on the connected load do not include current which is sold wholesale to a local lighting company in Manitou. The company has in all about 3,600 consumers. Of these about one-third are still on flat rate, but are being rapidly put on meter service. Sixteen buildings are heated with exhaust steam, their total cubical contents being 4,800,000 cu. ft. Exhaust steam is sold by meters, which measure the water of condensation. The street main system is that of the American District Steam Company. The rate on steam heating is 50 cents per 1,000 pounds, of steam condensed, with discounts of from 10 to 20 per cent, according to the amount of steam which is used.

The rates for lighting in the business district are on a two-rate contract. In the residential district they are on a single rate, for reasons explained later. Under the two-rate contract the consumer agrees to a minimum rate of $2.50 per month for each arc lamp and $3 per month for each twenty 16-cp lamps connected. For the equivalent of sixty hours used per month of the lamps connected, payment is made at the rate of 12½ cents per kw-hour. Power in excess of this amount is paid for at the rate of six cents per kw-hour. Residential lighting is on a straight meter rate of 12½ cents per kw-hour. The two-rate plan is not adopted for residences be-

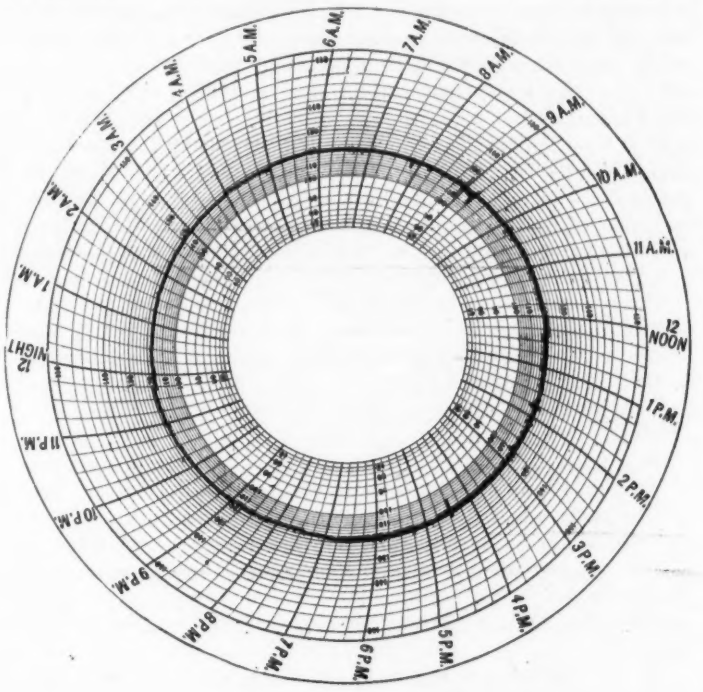


FIG. 7.—VOLTMETER CHART.

cause the management does not see how the company's sales could be increased by the adoption of that contract. Residences in Colorado Springs are liberal users of light and it is not likely that any improvement could be made either in the number of customers or the income by changing to the two-rate plan for residences.

Contracts for power service are made to include a minimum rate and payment per kilowatt-hour is made on a sliding scale, beginning with 10 cents per kw-hour for 150 kw-hours or less per month, and going down to 4½ cents for over 1,200 kw-hours per month.

The voltage regulation is excellent, considering the fluctuating load imposed by some of the large motors in the reduction mills, and the fact that the regulation has to be done by a single crank engine. Two recording voltmeter charts are reproduced herewith (Figs. 6 and 7.) One of May 9, 1905, showing the voltage for twenty-four hours with the plant of the Pike's Peak Hydro-Electric Company taking most of the load, fluctuations being taken by one generator in the steam plant driven by the high-pressure cylinder of the engine. The chart taken February 27, 1905, shows the voltage regulation obtained with the steam plant carrying all the load. A glance at these charts will serve to show the effectiveness of the Tirrill regulator in maintaining the voltage.

The office records are kept largely by card-index and loose-leaf systems. The account of each consumer is kept on a separate card, which shows his bills from month to month. By simply turning this card over in the filing case red indices are made to appear, which indicate whether a customer is delinquent or not. If a customer is not delinquent, the card is simply placed the other end up in the filing case, and the delinquent can be seen at a glance by the red indices. Meter readings are taken on a loose-leaf book. Each leaf has spaces for meter readings during six months of the current year and six months of the year previous.

The company is under the general management of George B. Tripp, formerly of Cleveland, to whose efforts the inauguration of the movement to get the Electric Light Convention in Colorado this year is due. For many courtesies shown in the preparation of this article acknowledgment is made to him and to Mr. Edward P. Dillon, electrical engineer of the company.

An Advertising Talk.

By John Craig Hammond.

IT'S easy enough for a man to tell or write all he knows—that is the average man.

Its easy enough for me to write all I know about advertising. But its hard work to write a story for the Electrical World and Engineer that will be interesting, instructive, and still not tell all I know.

There comes the rub.

A man with a new scheme or device that has "millions in it"—he hopes to get them out—does not as a rule give the scheme to the public until he has been well protected by patents.

I know of no way how certain ideas and theories of advertising can be patented.

If I did I believe that the millions in it would come out.

Howbeit, the question of selling more current and power to the public is of vast importance to every central station in the country.

That's what a central station is in business for—to sell the public current—the more they sell the better the statement at the end of the year.

There is a certain amount of business that comes to any station—comes without asking. But the virgin business—there's the big point—get the business that won't come until you have persuaded the prospect that he should come.

How much is it going to cost to educate the public?

What is the best way?

Will there be any profit left?

These are points of importance to the company paying the bills.

The auditor has a habit of acting this way:

"We did so much business last year at such a cost. We did so much this year at such a cost. We spent so much on advertising. Has it paid?"

Then the auditor goes to work to prepare a statement for the officials.

In other words you had a pile of money to the right in 1904 and did no advertising. To the left is another pile of money and you have advertised in 1905. Which pile is the larger?

That's the A B C of the results of advertising—which is the larger pile?

There's not a doubt in the world if I meet a man on the street and say: "Give me $1.48 cents and I will give you back $18," that the man would have heart trouble getting to a bank to get all the $1.48 cents on tap.

No doubt I am limited for space in this article. The Editors did not say so, but I must be. As a result it is impossible to give but an outline—and mind protecting the patent that is not a patent all the time and still keeping you, the reader, interested.

When I entered the gas and electrical field I knew something about theatrical, newspaper, medicine and food advertising—that is, I had had enough experience to lead me to think I knew something.

It fell to my lot to meet Henry L. Doherty, general manager and consulting engineer for the American Light & Traction Company.

"This man will be easy," I thought. "I will use a lot of expressions, talk figures, results, methods, and he will fall."

I started to talk. Mr. Doherty asked a question. I was surprised. He asked another and I was more than surprised. I took a grip on my chair, held fast, and then the old newspaper training came to my assistance and I asked a question.

I was lucky. I will never forget what followed. Here was a gas and electrical man who was a student of advertising—no, an expert. He knew more in an hour than I did in the day about the business, the theories, the practical side of the "game." He quoted data, gave ideas, jumped into the science of the business, explained why one form of advertising was not as good as another.

If a man was in danger of losing his nerve, I was the man.

But again I was lucky and managed to pull through the interview safe and sound.

I know something like 90 per cent—and the percentage is not boosted—more about the advertising business to-day than before I met Henry L. Doherty.

I have been given credit for some good schemes. They were not mine. They originated in the brain of Mr. Doherty. I executed them.

He taught me anew and I don't think he knows this fact—I am making a public confession.

For example, look at the Denver Gas & Electric Company. Returns on some parts of the business, due direct to advertising, have been as high as 63 per cent. Marvelous? Yes, more than that. Again the brain of Mr. Doherty at work.

I know some of the best advertising men in the country. They are not in the same class with Mr. Doherty. But there, I promised to tell something about the business. My only excuse for giving credit to Mr. Doherty is that the credit should rest where it is deserved.

I will give an example of how I would carry on a campaign in Blank City, say.

First would come the number of prospects—that is the people who use electric lights for light only. They are prospects for something else. The correct names—mind correct names—and addresses of each consumer on the book, must be secured.

What do they use—WHAT MORE CAN THEY USE?

Second the non-users in any form.

The power list—that is the people who have isolated plants, who are doing some part or all of their business with steam for power.

Third, the sign prospects and the window lighting and outline lighting. This last of the greatest importance.

Fourth, lay out a campaign to gain and deserve the good will of the public.

Start at the root of the evil—get good clerks in your office. Educate them that they are servants of the public.

The time has come when the old theory of: "You must buy light from us because we are the only company," is a thing of the past.

Be honest with the public, treat them fairly, go out of your road to do this—go miles—you can't go too far—remember this is the very foundation of advertising.

Spend $100,000 a year advertising and it can be ruined by ill treatment of the public.

Blank City has few electric signs—little or nothing but arc lamps. The names of the people who are prospects for signs have been secured. You start your campaign of education. You talk signs, explain how they work all night, bring forth a thousand good, strong, sensible business arguments—why a sign is a paying investment. And remember it is a PAYING investment.

Don't lie in your advertisements. Tell the truth. You are going to do business next year—that's the reason you advertise.

Don't try to "jolly" the merchant—talk facts. You have them on your side.

You insert daily ads. in the newspapers. They should carry a cut; they should be changed every day—mind every day; they should be "catchy" in execution; they should appeal not only to the prospect but to every one—this is important and is easy to do.

You get up attractive booklets; you send out circulars; a representative of the company is calling and talking all the time.

The campaign goes along and then you turn to personal letters. Say you have 2,500 sign prospects. A personal letter will cost you five and quarter cents. Lots of money? Yes. Will it pay?

Not unless you get out the right kind of a letter.

What is the right kind of a letter?

That's the patent—one of them. It has cost a heap of money to find the right kind of a letter—the letter that will bring answers—not answers alone—but letters that will bring business.

I have two men in my office—Mr. Frank Farrar and John Connelly, who can write a letter that will make a man give up his pocketbook and be happy at the same time.

Too strong a statement? No sir. Results show it—not that Messrs. Farrar and Connelly have secured any pocketbooks—but by their letter writing art—and it's a mighty big art—they have brought people into line—kickers, cranks, violent folks, and made them buy current. I know 20 of such people—the kickers and so-called cranks. They are using current now and are happy.

I want to break into the thread of the story for a moment. This is the reason: You don't have to do what the other fellow does. It's better to do it different. Why? The best reason in the world. I know men who were considered the top notchers of success. Other men have gone in and made a greater success—they had new ideas, better ideas. If you are barren of ideas, then follow the man who has made his ideas pay.

I know one big advertiser who said: "Why, you are doing this

against the old established rule. No one does it the way you are doing it."

"How much returns do you get on your way?" I asked.

"About 11 per cent," he answered, and he was proud.

"I get 19 per cent," was my answer, and I was happy.

That demonstrates to my mind that you don't have to follow the old rules.

Look at Mr. Doherty again. There's no doubt that a great many people found fault with the way he did business with some companies.

The question of whether he was right or wrong is answered by the success he has brought to the different properties under his management.

So again you don't have to do it like the other fellows. Advertising is as much in its infancy as the electrical world.

You stop and figure out what your current costs you to land at the factory door. You know what you get for it. The difference is your profit.

That's what you should do in your advertising. It's obvious that you can not spend as much money on booming a porch light for example as you can a hundred horse power motor or motors.

Use common every day business judgment in your advertising.

That's all.

But don't play with schemes—better be sure before you start for if you don't there's a heap of money that will be charged up to losses.

Don't overlook the small affairs. Take for example a candy electrical machine—a machine for making snowball candy. That machine is placed in a show window and is run by a motor from the central station. Maybe the current for a year will not amount to more than $50 for a year. But remember another point—you the Central Station man will get a certain amount of advertising out of that motor.

That the man with a big power bill will be jolted again with the possibilities of a motor goes without saying.

The closing down of an isolated plant by advertising is hard work. You must overcome the engineer, the owner and other employees. It's easy enough to send out a bright catchy letter with some up-to-date argument like the fact that John D. Rockefeller had to close down his private electric plant owing to the great cost, or that the Pennsylvania road has had to buy from a private company at different cities and on and on. All this helps. But keep at it.

Prop at this point, hit them at this point—hit them again—but hit in such a way that it won't become a tiresome subject to the prospect. Make your advertising as interesting as the most absorbing story—a story that a man won't stop reading until he has finished.

This can be done.

The Denver Gas & Electric Company is one of the pioneer companies in the country to take up advertising. That it has paid over and over again has been demonstrated.

There's a funny thing about this company—that is the question of prospects of all kinds.

A year ago there were 19,000 prospects. During the year hundreds and hundreds of appliances of all kinds were sold—I think the number was something like 8,000 new consumers. Two months ago the list was increased until the prospects amounted to 25,604.

A month ago several hundred appliances were sold, and to-day—that is two weeks after the report was made, the prospects had mounted to over 26,000.

This demonstrates the very important point that you are not going to run out of prospects. This point has been brought up time and time by the management. Maybe it was about time to let up because the prospects would soon run out.

Another case in example. Manager of the New Business Department, Williams, of Madison, Wis., made the following statement:

"When I took charge we had 400 gas range prospects. During the year we sold 550 ranges, and at the end of the year had 612 prospects left."

It's too long a story to give examples of the best way. Then, too, the terrible patent comes to the front.

If you want to increase the earnings of your company—net earnings—advertise. Don't advertise to-day and stop for a week, but lay aside a certain sum of money, figure out just what you want to do, figure out the best way and then go to it and stick and stick and stick again.

That's the way the profits grow.

After reading what I have written above, I decided that I had said enough on paper. For a week the manuscript was tossed among other papers. Then it was read again and this conclusion could not help from presenting itself: Even at the risk of being called "long winded" or "wordy," it's best to add a P. S. as it were.

Many engineers read the WORLD—with the permission of the editors I will guess that a majority of their readers are engineers.

Engineers I know gloat over figures. Words fall to the lot of other people in this world, but not to the engineer—he wants figures and data.

You can't give figures in advertising that amount to much beyond the statement of results. Results in one city will not be the same in another community. Of this there is little or no doubt.

It is an easy task to continue writing words about advertising, but the science—and do not overlook the fact that advertising is a science—is so far from being fully developed—that a man who is honest must confess he has done so and so, but he can't promise to do it to-morrow.

Advertising experts will sneer at this statement. Let them do the sneering, you do the thinking.

A business man once said: "Advertising is so difficult that astronomy becomes boy play in comparison."

How to write copy?

Illustrate it—if so, what way?

Personal letters, booklets, circulars—what's the best way?

Your expert will come back and say: "I can key my ad—meaning he can have a catch that will show the exact results.

You can key certain ads at certain times for a certain length of time.

You can't do it any longer.

When is the proper time to stop?

I once wrote a series of what is termed personal letters. One of the best advertising experts in the country read them with care. Then he said: "They are 'smarty' letters. You could not forget the fact that you were an advertising man. You did not go deep enough. Those letters are rotten."

He is plain in words—is this expert, as the above quotation will demonstrate.

But this expert was wrong. HE had not gone deep enough. They were 'smarty' letters; they were marked bold with the ad. man's craft. But that was the kind of a letter needed at that time—the follow-up campaign was in such shape that that was the style of letter wanted.

And then the letter brought the results expected.

So the expert was wrong.

Water boils at a certain degree at sea level. It boils at another a mile above the sea.

Wouldn't an engineer have to take this condition into consideration if he was planning a new plant?

I am not enough of an engineer to say yes, but I should guess yes.

I know some coal will make so many pounds of steam, while another will show a much lower average.

This being true, it would be impossible to operate the plants on the same basis.

This holds good in advertising.

Then comes one more point. A man with street car space to let will show you the number of people who ride on a car in a year's time. He will show you how much a card for a year will cost in the cars. He will reduce this to figures and percentages and show you how much a prospect will cost.

A billboard man will do the same thing. The newspaper advertising man does likewise—so does the program man—the man with a fan with your ad on it—and on down the line until you are lost in the whirl of the "novelty" man who is sure "the ad will be placed in every kitchen and there my dear sir, it will remain day after day always calling to the lady of the house that she needs to use such and such a butter."

And this can be figured out—it has been many times. It's the A. B. C. of the business. And still you have not the answer.

A page ad in a theater program will do certain things for certain business under certain conditions.

Say you had a dollar a pound candy to advertise. You would not place the ad in a 1 cent vaudeville theater program, would you? Of course not, for the patrons of this class of a theater are not buying $1 a pound candy.

How many people read a theater programme? Stop and count the number some night. What class of patrons read them? Stop and think that over. May be you want to sell soap and have enough money to go into any old thing. Every one is a prospect for soap, or should be. But say you have only 2,000 merchants who can use electric signs. What are you going to do—go into theatre programmes, on billboards, etc.? Hardly—you will go to the newspaper for the very reason that it is the best medium if you have good copy.

What is good copy?

Not many people agree on this subject. What's good to one man is foolish to another.

But there, let's don't get dizzy over the question. There is no need of doing so. Use common sense—stop and think—think for one week hard and long on what's the best way, what's the best kind of copy—then don't do what you think is right. Stop and think another week—lift up a few more pages, dig a bit deeper; you are a long ways from the bottom—the foundation—so just keep digging, trying it again, rewriting, thinking, using common sense—heaps and heaps of this—and then may be if you are lucky you will be all right.

But advertise.

A Diagram of the Circuits of the Dynamotor.

BY A. E. KENNELLY AND S. E. WHITING.

IT is well known that an alternating-current transformer, by which a secondary circuit is inductively, or magnetically, associated with a primary circuit, is equivalent to a conductive connection between the two circuits, in such a manner that the secondary circuit is placed in series with the primary winding, but is shunted by the impedance of excitation.*

In accordance with the above considerations, the circuit diagram

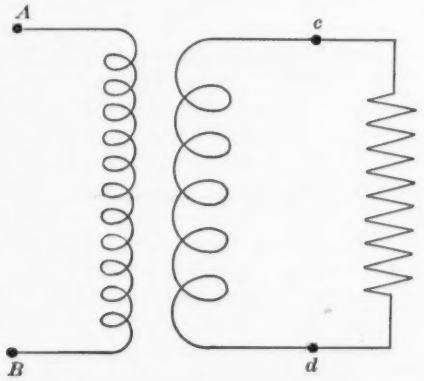


FIG. 1.—DIAGRAM OF CIRCUITS OF A STEP-DOWN TRANSFORMER.

of a transformer, as represented in Fig. 1, wherein the primary and secondary coils are inductively associated in the ordinary way, may be converted to that of Fig. 2, in which the ratio of transformation is unity; or in which the transformer is *level*, as distinguished from step-up or step-down. This again may be converted into the electrically equivalent circuit diagram of Fig. 3, in which both windings are conductively connected.

It is the purpose of this article to show that the same principles of graphic representation apply to the circuits of the dynamotor, or direct-current transformer, in which two mutually insulated armature windings, connected each with a commutator, and mounted on a common armature core, rotate in one and the same magnetic field, as indicated in Fig. 4.

Considering the armature circuits of the dynamotor (Fig. 4), they may be represented as in Fig. 5, where e_1 is the e.m.f. at primary terminals (volts), r_1 the resistance of the primary winding, including commutator and brushes (ohms), i_1 the primary current (amperes), e_{11}, r_{11} and i_{11} being the corresponding quantities at secondary terminals. It is clear that no change will be made in the energy relations of the system if the secondary circuit be converted, or referred, to the pressure of the primary circuit, by making the number of secondary armature turns equal to the number of primary turns, with the same amount of copper. The external resistance of the secondary circuit, R_{11}, is thus altered to $n^2R_{11} = R$ ohms; where $1/n$ is the ratio of transformation in Fig. 5. The internal resistance of the secondary winding is similarly changed

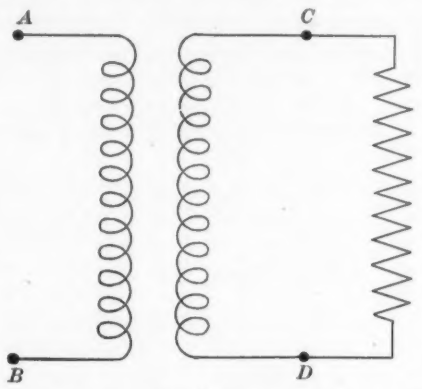


FIG. 2.—DIAGRAM OF CIRCUITS OF EQUIVALENT LEVEL TRANSFORMER.

from r_{11} to $n^2r_{11} = r_2$ ohms. The voltage is changed from e_{11} to $n\,e_{11} = e_2$ volts. The current is changed from i_{11} to $i_{11}/n = i_2$ amperes. We thus obtain the equivalent level dynamotor condition represented in Fig. 6. Here the primary and secondary armature windings have equal numbers of turns and generate equal

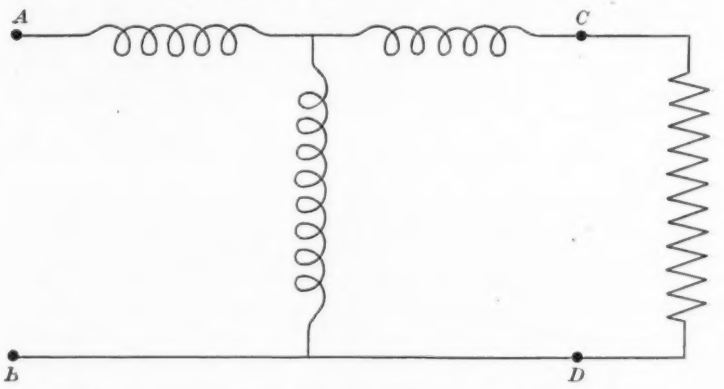


FIG. 3.—EQUIVALENT DIAGRAM OF LEVEL TRANSFORMER.

induced e.m.f's during rotation. The currents and voltages in the two circuits are also substantially equal under load.

At no load, or open secondary circuit, in Fig. 6, the conditions in the primary circuit will be:

$$e_1 - i'r_1 - e_0 = 0 \quad volts,$$

where e_1 is the e.m.f. impressed at primary terminals, AB; e_0 is the c.e.m.f. of rotation and i' the no-load current, or the current

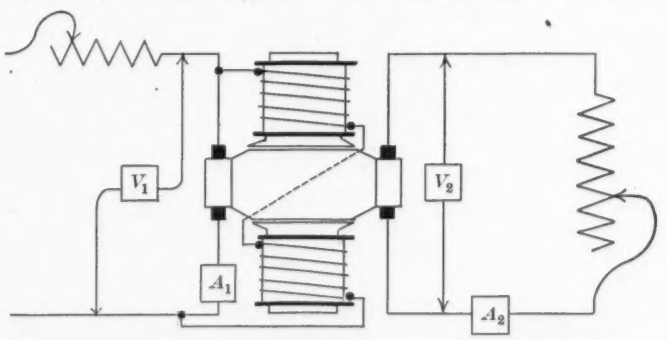


FIG. 4.—DIAGRAM OF CIRCUITS OF SHUNT DYNAMOTOR OPERATED AT VARIABLE LOAD AND CONSTANT PRIMARY VOLTAGE.

whose torque overcomes the friction of rotation. The e.m.f. in the secondary winding will also be e_0 volts.

When the secondary winding is loaded by closing it through the external resistance, R ohms, the secondary current strength will become, say, i_2 amperes, and an equal current strength will be added to the primary winding to neutralize the secondary m.m.f. The conditions will then be

*Houston and Kennelly, "Electrical Engineering Leaflets." Advanced grade, No. 32, p. 255, 1897. Houston and Kennelly ELECTRICAL WORLD AND ENGINEER, Oct. 30, 1897. C. P. Steinmetz, "Alternating-Current Phenomena," p. 183, 1897. A. E. Kennelly, ELECTRICAL WORLD AND ENGINEER, p. 343, Sept. 2, 1899.

$$e_1 - (i' + i_2)\, r_1 - e_0 = 0 \quad \textit{volts} \text{ in primary circuit,}$$

and $e_0 - i_2\,(r_2 + R) = 0$ *volts* in secondary circuit,

volts.

or $e_1 - (i' + i_2)\, r_1 - i_2\,(r_2 + R) = 0$ *volts.*

But the last equation corresponds to the circuit diagram of Fig. 7, where the primary and secondary circuits are connected together in series, with the shunt, r, representing the leak of frictional current. The voltages, currents and power in this system will be

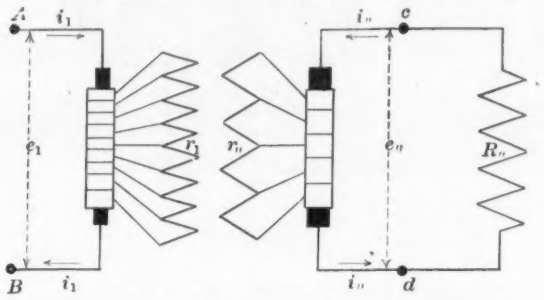


FIG. 5.—CIRCUIT DIAGRAM OF A STEP-DOWN DYNAMOTOR.

identical with the corresponding quantities in the arrangement of Fig. 6. The constant leak resistance, r, involves the supposition that frictional torque and the current at no load increase directly as the speed of rotation, within the range of speed variation of the armature between no load and full load, the field excitation being constant. That is, if the friction current is, say, 1 amp. at no load, when the speed is, say, 1,000 r.p.m., and there is no appreciable drop in the primary winding, then the friction current will be 0.95 amp. at full load, when the speed has fallen to 950 r.p.m., and there is 5 per cent. drop in the primary winding. This proposition is probably inaccurate; but the degree of error involved within the range of practical drop in pressure and speed seems to be negligible.

In order to check this theory, the authors tested a small dynamotor kindly loaned for the purpose by the Holtzer-Cabot Company. This machine transforms from 220 volts to 11 volts (direct current), with a full-load output of 80 watts (8 amp. at 10 volts). The resistance of the primary brushes, commutator and winding was found to be 9.63 ohms (warm), and of the secondary 0.1132 ohm (warm). The ratio of transformation being $1/n = 1/20$, the equivalent level resistance of the secondary winding was $0.1132 \times 400 = 45.28$ ohms. The voltage at primary terminals was supplied by a storage battery and kept constant during the tests at 220 and 110 volts successively. The electrical connections in the test are shown in Fig. 4.

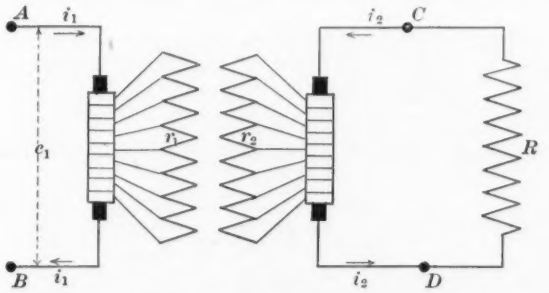


FIG. 6.—CIRCUIT DIAGRAM OF THE EQUIVALENT LEVEL DYNAMOTOR.

Primary current.				Secondary circuit				Apparent resistance of dynamotor.	
e_1 volts.	$i_1=i'+i_2$ amperes.	$p_1=e_1 i_1$ watts.	Speed r.p.m.	e_{11} volts.	i_{11} amp.	$p_{11}=e_{11} i_{11}$ watts.	$e_{11} i_{11}=R_{11}$ ohms.	$\frac{e_1}{i_1}=R_1$	R_1 computed ohms.
220	0.400	88.	1650	10.95			∞	550	
220	0.502	110.4	1643	10.65	1.98	21.1	5.33	428.3	442.6
220	0.570	125.4	....	10.44	3.55	37.1	2.942	386	385.1
220	0.618	136.0	....	10.28	4.475	46.0	2.298	356	356.0
220	1.040	228.8	1625	9.18	12.84	117.9	0.715	211.6	215.0
220	1.320	290.4	1610	8.40	18.32	154.0	0.458	166.7	170.2
110	1.175	129.3	1085	2.90	17.40	50.45	0.1667	93.6	94.0
110	0.622	68.4	1136	4.38	6.40	28.02	0.684	177	179.3
110	0.417	45.87	1147	5.02	2.175	10.91	2.307	263.8	266.8
110	0.303	33.33	1180	5.42	0	0	∞	363	....

In the above table the first three columns show the conditions at the primary armature terminals of the dynamotor under test, as indicated by the voltmeter, V_1, and the ammeter, A_1, in Fig. 4. The fourth column gives the observed speed of rotation. The next four columns give the conditions at secondary terminals, as indicated by the voltmeter, V_2, and the ammeter, A_2. The ninth column contains the apparent resistance of the primary winding of the armature under load, measured at the terminals, and as deduced from the entries in the first two columns. The last column gives the computed resistance at primary terminals according to the circuit diagram of Fig. 7, and to the formula, $R_1 = r_1 + \dfrac{r\,(r_2+R)}{r+r_2+R}$ ohms. It will be seen that the agreement between the last two columns is satisfactory.

It seems likely that this agreement would be as good, or even better, in the case of larger dynamotors.

Not only then is the dynamotor the equivalent in the direct-current system of the transformer in the alternating-current system, but it is subject to the same equivalent circuit diagram, wherein the inductive relation is changed to a conductive relation, after the transformation ratio has been made equal to unity, or level transformation has been assumed. The rotation of the primary and secondary windings in the constant field of the dynamotor is the equivalent of the alternation of magnetic flux through the primary and secondary stationary windings of the transformer. The equations of the transformer are the counterpart of those of the dynamotor, given above, when interpreted vectorially.

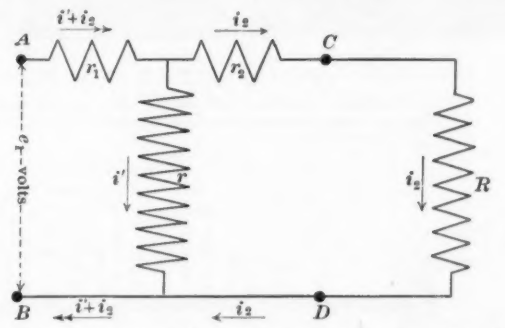


FIG. 7.—EQUIVALENT CIRCUIT DIAGRAM OF LEVEL DYNAMOTOR.

Some European High-Tension Switchboards.—I.

BY PROF. DR. F. NIETHAMMER.

THOUGH, with the exception of the water power transmissions of the Alps, the necessity of using e.m.f's above 20,000 volts occurs much more rarely in Europe than in America, there already exists various European power transmission systems using e.m.f's between 20,000 and 40,000 volts, mostly erected by Swiss electrical concerns. Ere long a direct-current transmission system using as much as 60,000 volts will be completed by the Thury Company, of Geneva, for the town of Lyon in France; eight direct-current generators for a maximum of 7,500 volts each, and a constant current of about 50 amp. will be switched in series. The switchboards form one of the most important parts of these high-tension plants. The present article describes one of the most interesting of the high-tension switchboards now in use.

The old town of Venice recently completed a large hydro-electric power plant at Cellina, the transmission e.m.f. being 30,000 volts. The central station contains six 1,800-kw, three-phase generators designed for 315 r.p.m., and 3,700 to 4,800 volts, directly connected to horizontal water wheels. The entire electric installation has been furnished by Brown, Boveri & Cie, Switzerland.

The arrangement of the whole station, including generators, exciters, switchboards and transformers, may be seen from Figs. 2, 4 and 5; four of the main generators are, however, omitted in these drawings. *A* represents the floor for the low-voltage switchboards, one of them in the shape of a desk. On these boards there are assembled all measuring instruments and synchronizing apparatus, the levers and hand wheels for all main switches and resistances. Alternators, exciters and transformers and transmission lines are ex-

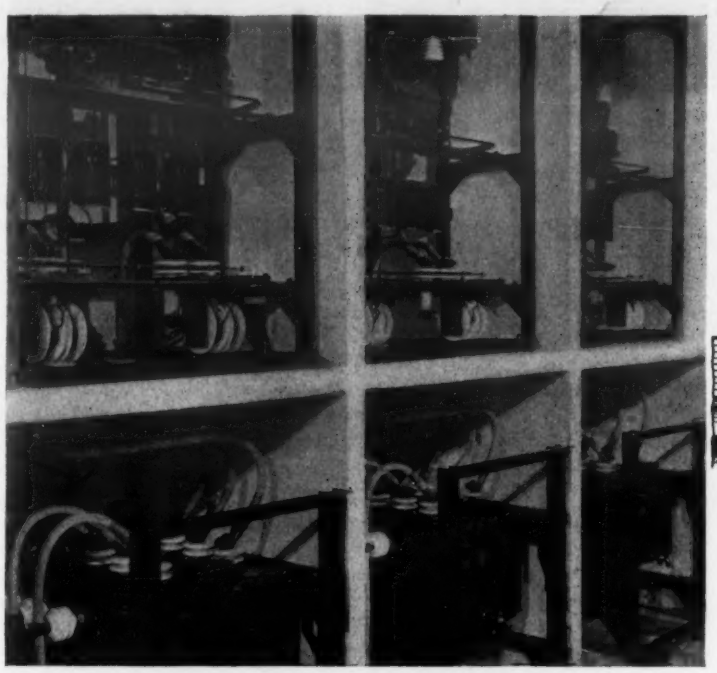


FIG. 1.—CONCRETE CELLS FOR SWITCHES.

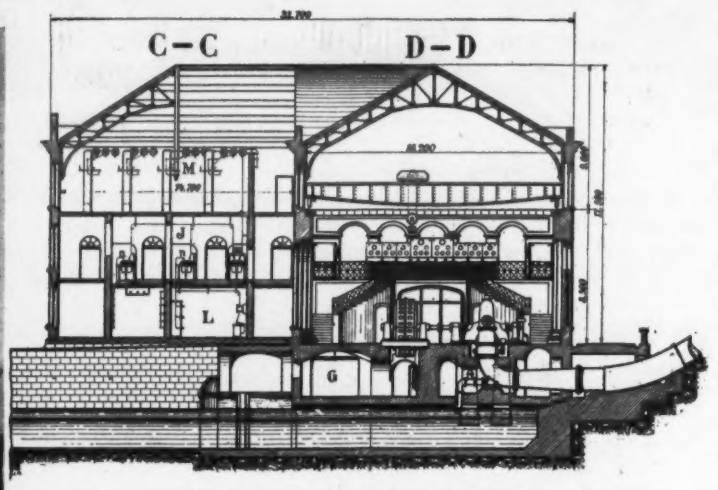


FIG. 5.—TRANSVERSE SECTION OF POWER PLANT AT CELLINA.

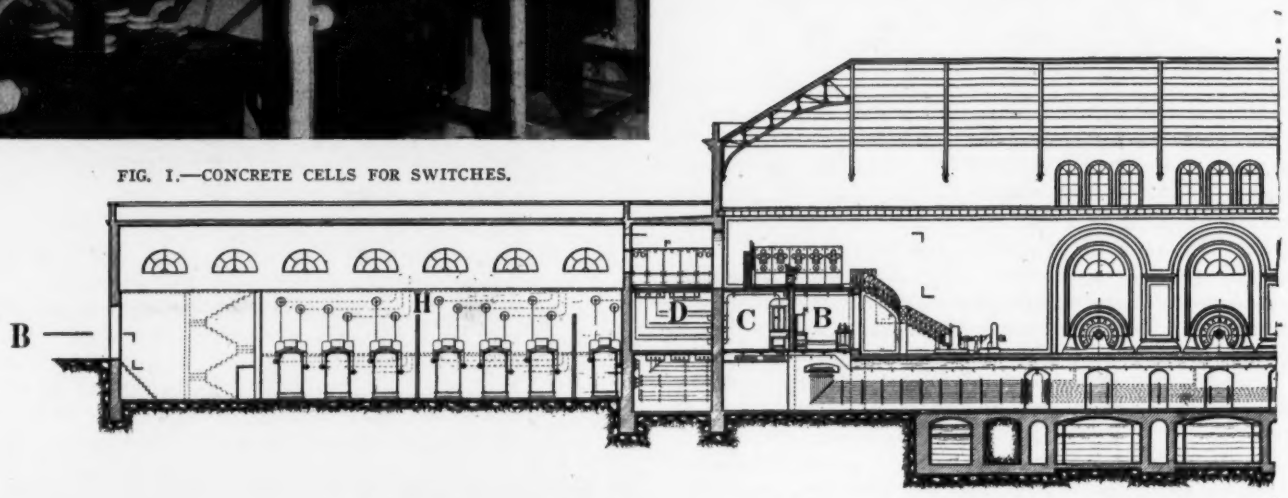


FIG. 2.—LONGITUDINAL SECTION OF POWER HOUSE AT CELLINA.

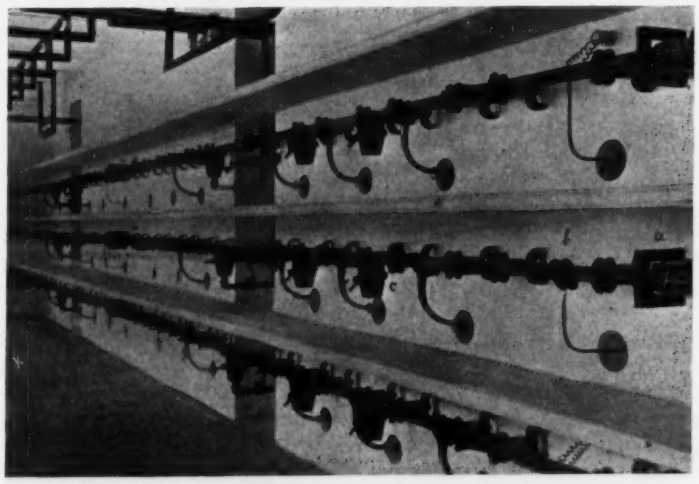


FIG. 3.—RING-CONNECTED BUS-BARS.

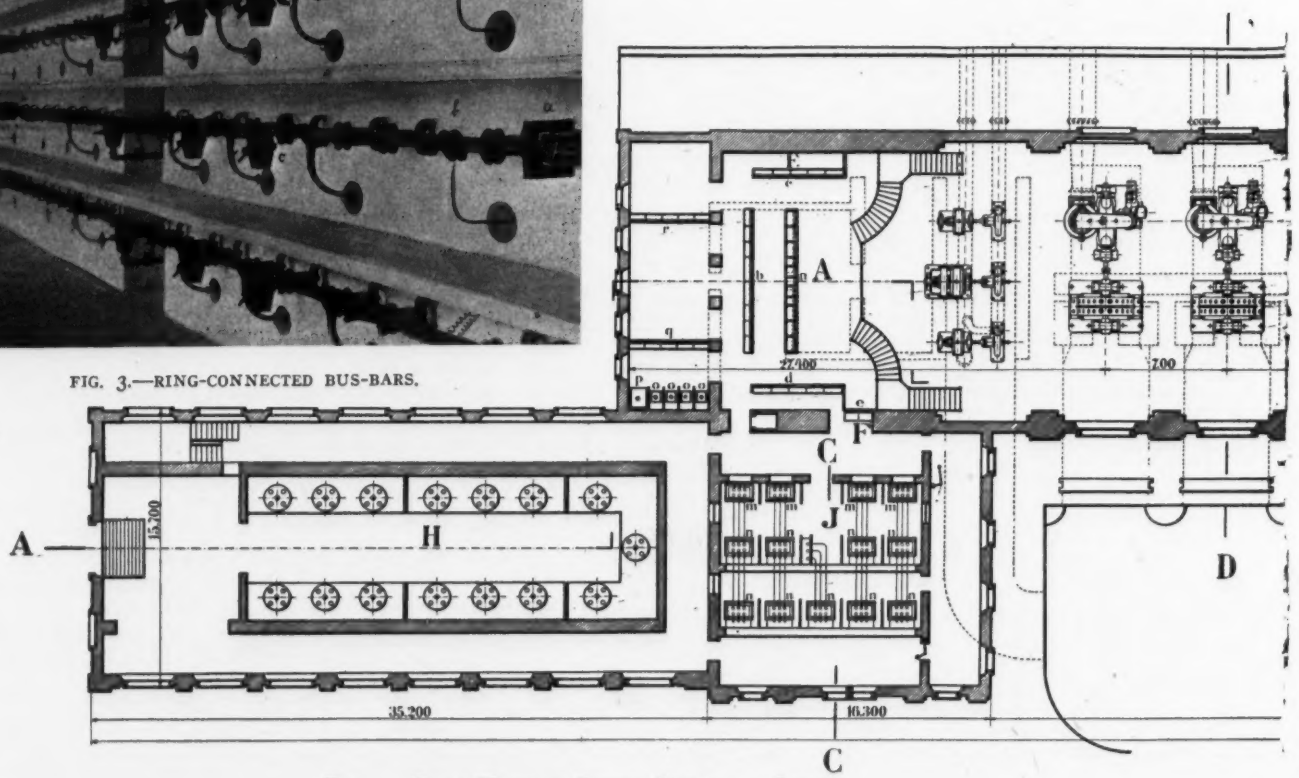


FIG. 4.—PLAN VIEW OF POWER HOUSE AT CELLINA.

SOME EUROPEAN HIGH-TENSION SWITCHBOARDS.

clusively controlled from this group of boards. The boards *A* are subdivided into parts *a*, *b*, *c*, *d* and *e*; *a* is a switching desk for alternators and exciters; *b* contains the measuring instruments and the relays for the automatic switches of the alternators; the bus-bar instruments are also on this board; *c* contains the measuring instruments, relays and switch-levers for the low-voltage circuits of the transformers; *d* contains the measuring instruments, relays and

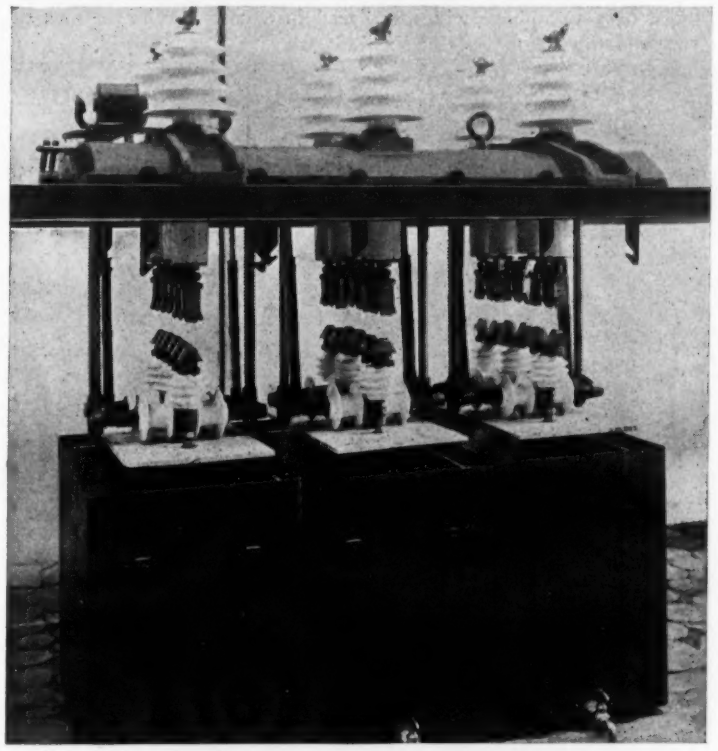


FIG. 6.—OIL SWITCH FOR 40,000 VOLTS.

switch levers for the high-voltage circuits of the transformers and for the outgoing lines; *E* is a switch board for the electrically driven exciters.

B and *C* are rooms below the boards *A*. One of them contains the rheostats and exciter switches and all other apparatus for the alternators. *D* is the ring-connected bus bars for 4000 volts.

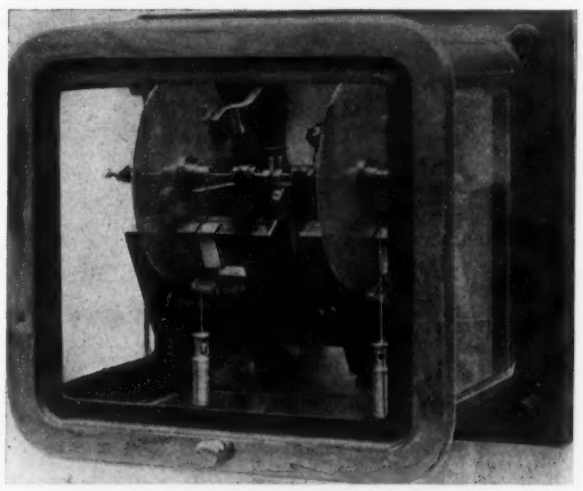


FIG. 7.—OVERLOAD RELAY.

E shows switches and apparatus for the low-voltage circuits of the transformers. *F* is the apparatus for the electrically-driven exciter.

G is the cable duct between the generators and the cells *C*. *H* is the transformer room. *J* is switch room for the outgoing 36,000-volt lines; *m* automatic oil switches; *n* non-automatic switches. *L* is high-tension bus-bars. *M* a room for the lightning arresters, from this room branch off the long-distance lines. The lightning arresters are a combination of a horn, zinc cylinders, carbon resistances and a choking coil; *o*, *p*, *q* and *r* is designed for local circuits and contains switches, transformers and switchboards for the power and lighting of the central station and of the surrounding buildings.

The length of the whole station is 116 meters, and the greatest breadth is 33 meters. There are three special turbine-driven exciters of 130 kw each. One of them is connected also to a synchronous motor which may work either as a generator or as a motor. The transmission line between the central station and Venice is about 90 kilometers (56 miles) long, and consists of 12 wires, each of 53 square millimeters section. To raise the three-phase e.m.f. from 4,000 to 36,000 volts, there are used 15 1,000-kw, single-phase water-cooled oil transformers, each group of three transform-

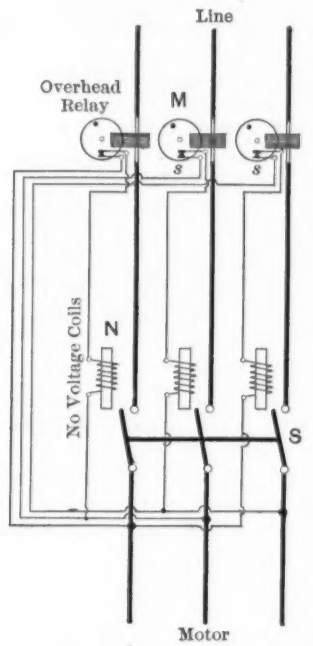


FIG. 8.—OVERLOAD AND NO-VOLTAGE DEVICE.

ers being surrounded by concrete walls. The electromotive force at Venice is kept constant at 27,800 volts.

The alternators work on a ring-connected bus-bar system, as

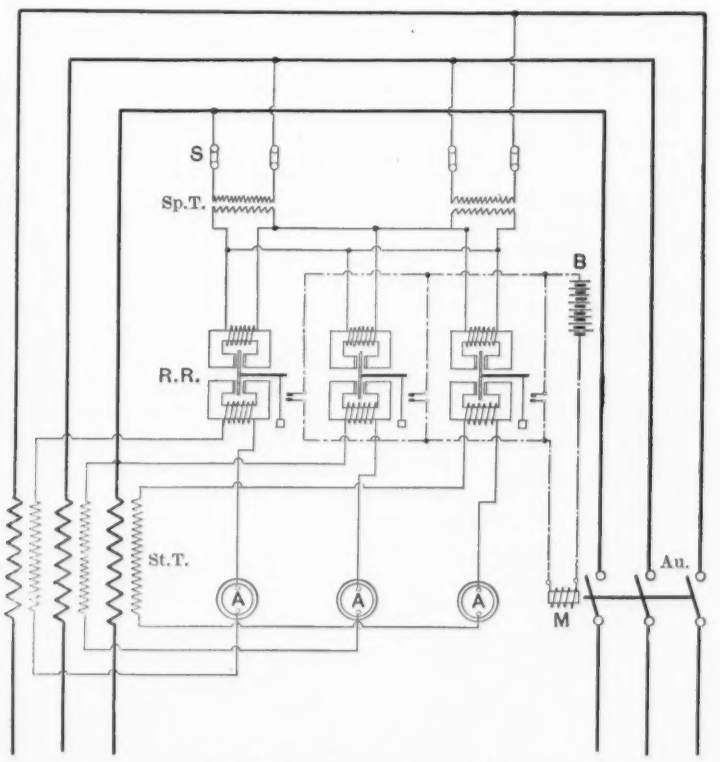


FIG. 9.—REVERSE-CURRENT RELAY.

shown in Fig 3. The three bus-bars are separated from each other by partitions of concrete or marble, the connections to the alternators and transformers being led through holes in the wall insulated by glass tubes, and the current transformers being mounted directly

on the bus-bar. All oil switches, voltage transformers, instrument fuses, etc., are enclosed in separate concrete cells, illustrated in Fig. 1. The usual design of the oil switches of Brown, Boveri & Cie is employed. The cover, on which all contacts are fastened by means of porcelain insulators may readily be removed for inspection; each phase is within a wooden partition. The oil-switch, Fig. 6, is designed for 40,000 volts. Each phase has eight interruptions in series, and is provided with a special oil tank. Most of the oil switches have an overload relay with a time-element, as shown in Fig. 7. The overload current turns an aluminum disc which raises a small weight, this in its turn closes an auxiliary circuit thereby opening the main-switch.

With the overload time element is also combined no-load or no-voltage devices and reverse-current devices. The no-voltage device is especially advantageous for the protection of high-tension motors. The scheme is shown in Fig. 8. The main switch, *S*, is kept in the closed position, as long as the three coils, *N*, are excited by the terminal voltage. Each voltage circuit contains also an auxiliary switch, *S*, which, left to itself, is continuously kept closed. This auxiliary switch is mounted on the overload induction relay, *M*, and is opened as soon as the weight of this relay is carried into its upper position by any over-load curent. The interruption of this voltage circuit disengages an interlocking device and opens the main switch, *S*. The same effect takes place as soon as the voltage falls to zero. The reverse-current relay consists of three aluminum discs, each of which is influenced by two laminated magnets. One of these magnets is excited by a series transformer, *St. T.* (Fig. 9), the other by a voltage transformer, *Sp. T.*, connected to one of the line voltages. As soon as a machine changes from a generator into a motor, the torque exerted on the disc is reversed and the discs wind up a small weight which closes an auxiliary circuit of a storage battery, *B*. The direct current excites an electromagnet, *M*, which opens the main oil-switch.

Utilization of the Exhaust Steam From Turbines.

BY FRANZ KOESTER.

THE recent addition of a turbo-generator to the equipment of the brewery "d'Orangeboom," in Rotterdam, one of the oldest and largest breweries in Holland, serves to prove that the steam turbine has, in brewery service, many advantages over the reciprocating engine. These advantages can be attributed to the nature of the exhaust steam which in breweries may be used in many auxiliary processes such as the manufacture of ice, and heating of water (by jet condensers) for the boilers and for flushing beer barrels, etc. A short description of the installation and operation of this turbine plant may, therefore, be of some interest. Previously this plant consisted of one 700-hp, horizontal reciprocating engine used in operating an ice machine, a line of shafting and a 130-kw generator, which supplied direct current to the various motors in the factory as well as to the electric lights. The fact that the large engine ran uneconomically on light loads at certain times induced the owners to install an additional electric unit. The available space did not allow of the installation of an additional reciprocating engine of the required capacity, and the owners, therefore, were forced either to erect a new power house or to install a steam turbine. During the negotiations it became known that the turbine possessed another great advantage in that the exhaust steam, on account of its freedom from oil, could be used advantageously elsewhere in the brewery. Previous to this time water, which was drawn from a reservoir in an upper story, had been heated to a temperature of 195 degrees F. by means of fresh steam at the lower delivery points. On account of the large amount of steam required in this process, it was decided to utilize the above mentioned advantage of the steam turbine by bringing the exhaust steam into direct contact with the water used for flushing purposes. In using the exhaust steam from a reciprocating engine a surface condenser is necessary, and the temperature of the water can be raised only 60 or 90 degrees F.

The turbo-generator installed is of Messrs. Brown, Boveri & Co.'s standard design, built for a working pressure of 140 pounds, 130 degrees F. of superheat with an output of 130 kw at 3,000 r.p.m., and a voltage of 115-120. The floor space required is 18.1 ft. by 3.9 ft. The shafts of the generator and turbine are connected by a flexible clutch coupling and rest in three bearings. The generator is of the C. E. L. Brown design, for direct connection to steam turbines (see Fig. 1). Special attention has been given to the design of the armature on account of the high peripheral speed to which it is subjected.

The field core is provided with a compensating winding in addition to the ordinary winding in order to counteract the magneto-motive force of the armature current, the two windings being arranged as a two-phase winding placed in a core similar to that of

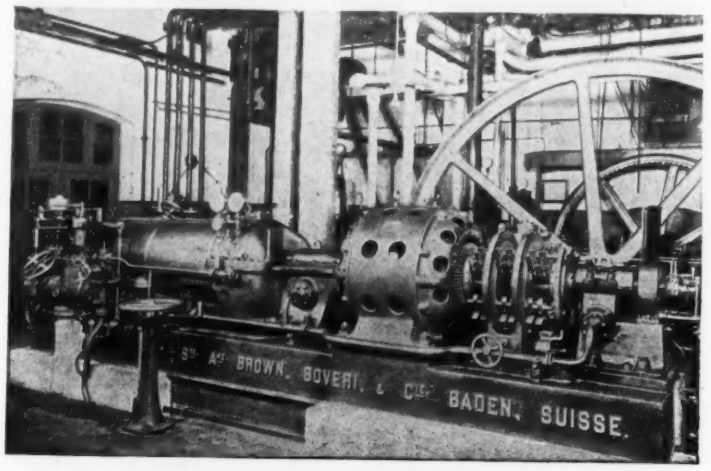


FIG. 1.—130-KW TURBO-GENERATOR.

the stator of an asynchronous motor. The compensating field winding is connected in series with the armature winding, so that any variation in the armature current causes a corresponding variation in the compensating current, thus completely eliminating the field produced by the armature current, and getting rid of the difficulties of commutation so that the machine works practically sparklessly at all loads, without the necessity of shifting the brushes.

It is unnecessary to describe the details of construction of the

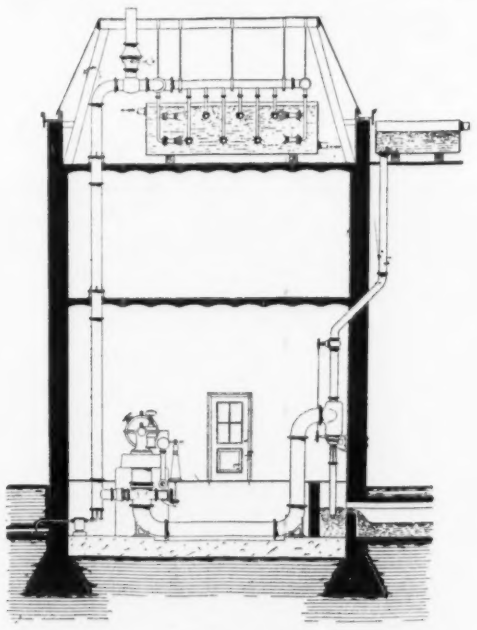


FIG. 2.—CROSS-SECTION OF POWER HOUSE.

Parsons turbine, as they are already well known. The generator and steam turbine, mounted on a common bed plate, are placed on the foundation without bolts, as there is no tendency to creep.

At the exhaust ports, directly under the turbine, there is installed a two-way valve, by means of which steam may be exhausted into either of two pipes, one leading up to the hot water installation, the other leading to a jet condenser. When using the exhaust steam for heating the water in the tank at the top floor of the building the steam consumption is, of course, greater than when exhausting into the condenser. As will be noted in Fig. 2, the jets into the water tank are of different lengths, the whole system being so arranged that when the quantity of exhaust steam is small only the short jets

operate, while under heavy loads all the jets operate. An automatic valve is so arranged in the main pipe that the number of jets in operation is controlled according to the quantity of exhaust steam, and thus the plant always works at the highest efficiency with comparatively little attendance. As will be seen in the illustration, provision is made for exhausting into the atmosphere and also, by means of valves, to prevent any water from entering the turbine when the latter is operating condensing.

The installation of the Koerting condenser as shown to the right in Fig. 2 was made at small first cost as water under pressure for cooling purposes was already available. With this system it was possible to obtain a 27.2-in. vacuum at full load. Aside from the low cost of maintenance entailed on account of this simple automatic arrangement, a large saving in coal results from the direct use of the steam for warming the flushing water.

The turbo-generator was originally intended to be used as a spare unit, but after having been tested, the plant was observed to operate so economically that the turbine was finally considered as the chief unit, and run whenever flushing water was required.

Although at the present day in the manufacture of ice the compressor-refrigerating system is employed almost exclusively, a new field has been opened for utilizing the exhaust steam from the turbine in combination with the ammonia-absorption system. The steam for this purpose does not come directly from the boiler, as was the original custom, but there is used exhaust steam by which means a reasonable quantity of warm water, as well as crystalline ice, is produced.

The ammonia-absorption system is based on the following prin-

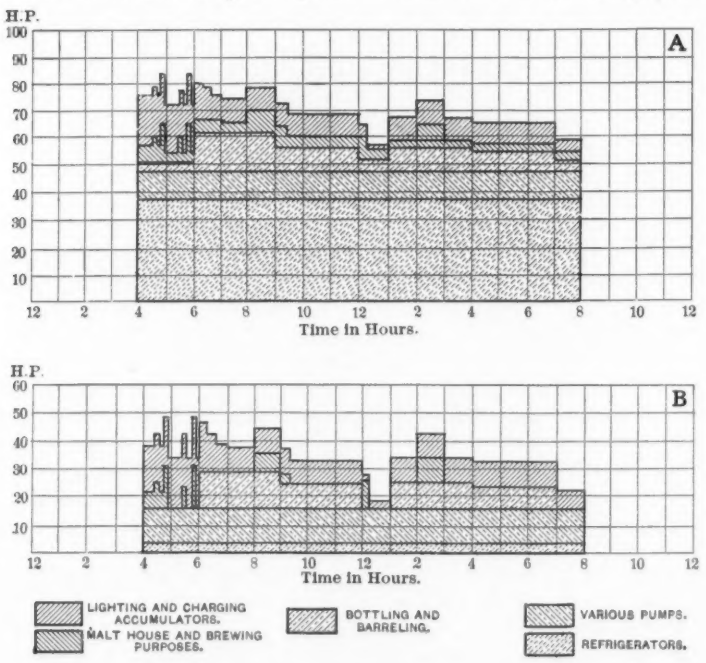


FIG. 3.—COMPARATIVE DIAGRAM OF POWER CONSUMPTION.

ciple: A quantity of anhydrous ammonia is placed in a retort and the temperature raised by passing the exhaust steam through tubes arranged inside. The solution being brought to the boiling point, the hot gases are led under pressure into a condenser where they are liquefied. The liquid ammonia is then led into an evaporizer, where it expands and absorbs heat. After performing its work, the warmed gas is led into an absorber where it is dissolved in cold water. The saturated solution of ammonia is then pumped into a heating tank and afterwards led back to the first mentioned retort.

As only a small amount of heat is taken from the exhaust steam when passing through the retort, the condensed steam, which is free from oil, is collected and used for boiler feed water. The exhaust steam which is not passed through the retort is passed through a condenser and the condensed steam stored in reservoirs at different temperatures. Thus by drawing some water from the mains it is possible to store water at a temperature of from 80 to 90 degrees C. and also at 15 to 20 degrees C., the former being used for boiler feed water, the latter for freezing, while the water used in the condenser may be obtained at 45 to 50 degrees C. for flushing, and at about 90 degrees C. for brewing. By this arrangement not only is the total heat of the exhaust steam made use of in a thorough manner, but a much smaller amount of energy than before is required for operating the entire brewery plant

The diagrams of Fig. 3 represent a comparison of the relative average daily power required during one year in a North German brewery with an output of 35,000 hectoliters; *A* showing the power required when operating a compression refrigerating plant and reciprocating engines; *B* showing the power required when using an absorption refrigerating plant and turbines as described above. In place of the lowest large square in *A*, which represents an output of 37 hp, a small strip representing about 2.5 hp is seen in *B*. This is equivalent to the power required to force the ammonia out of the absorber into the retort. The figures show that during normal working this method of using the heat in the exhaust steam serves to produce a sufficient quantity of feed water at a temperature of from 50 to 70 degrees C., and simultaneously a sufficient quantity at 90 degrees C. for brewing, and enough water at 50 to 60 degrees C. for various flushing purposes.

The steam consumption is not proportional to the work done, for in diagram *A* work is done with free exhaust only from 4 to 12 A. M., while in diagram *B* work is done during the entire day with free exhaust. There is, however, a saving of 35 per cent in the steam consumption of the latter. With this lower steam consumption, of course, a correspondingly reduced amount of coal is required.

It may be noted here that the ice produced by the above method from the condensed steam is clear and crystalline and not of a milky appearance. The great advantage and durable quality of this kind of ice are well known.

Since the main unit, that is, the compressor-refrigerator, is dispensed with through the adoption of this system, and since a large number of machines are run only temporarily, electricity may be advantageously used for driving the various units, thus eliminating the long lines of shafting, which waste an unnecessary amount of energy when running light for a large part of the time.

In the above, breweries are dealt with exclusively, since with them are obtained the most marked economies on account of this system. It is self-evident, however, that the same system can be used advantageously also in slaughter houses, cold-storage warehouses, chemical factories and any other plants requiring artificial cooling apparatus.

This exceedingly economical system of refrigeration may also be used for cooling the air used for ventilation in theatres, ships, etc.

Lightning Research.

In a recent report of the lightning research committee of the Royal Institute of British Architects and the Surveyors' Institution, Sir Oliver Lodge gives a summary of the most modern and accepted theories regarding lightning phenomena. He points out that the problem is to get the discharge to earth in such a way that it will cause the least disturbance. To dissipate the energy of a lightning flash suddenly is just as sensible as stopping a flywheel or a train suddenly. A lightning conductor of perfect conductivity, if struck, would deal with the energy in far too rapid and sudden a manner, and the result would be equivalent to an explosion; a conductor of moderately high resistance, such as iron wire, would get rid of the energy in a slower, and therefore much safer, manner. Of course, there is a limit to the resistance of the conductor, for if it be too great then fusion will result. He considers, first of all, the ordinary lightning discharge from cloud to earth and calls this stroke A. There is, however, another and far more dangerous condition, viz., when a discharge passes between two clouds situated vertically one above the other. Then, when the free charge on the earth side of the lower cloud is suddenly relieved, the disruptive discharge through the dielectric which has not been strained previously is more violent and may take an extremely erratic course. The result is that no leakage arrangement, such as a point or number of points, is effective. This type of discharge is designated as the B stroke. In the case of an ordinary building it suffices to provide an invisible cage of wires, descending vertically down its salient features, any metal being suitable. Even this precaution will not prevent a flash of type B, and it does not appear that there is any device in existence capable of doing so.

Electrically-Driven Printing Plant in Worcester.

A modern motor-driven printing plant has recently been placed in operation at 6 Walnut Street, Worcester, Mass., by F. S. Blanchard & Co., a long-established concern of that city. The equipment of the house was formerly operated by the old belting and line shaft method, but in its new quarters the firm decided to install a thoroughly up-to-date layout and consequently selected the individual motor drive for each press. The plant comprises eight presses, two linotype machines and a paper cutter, and all this machinery is set up on concrete foundations in a work room 80 ft. square adjoining the office. The racks for the storage of type, plates and other supplies are also placed in this room. At one side, nearest Walnut Street, is a wooden incline connecting the doorway and the floor, for convenience in handling paper, trucks, etc.

Power is supplied to all machines by the Worcester Electric Light Company through a 500-volt, direct-current commercial circuit. For special lighting 40 104-volt alternating-current incandescents are about to be installed at the various presses. These will also be furnished with current by the same company. All the wiring to the motors, controller and rheostats is executed in iron-armored conduits, circular loom conduit being used in a few cases at the rheostats. The power circuits for each machine are brought up through the floor in conduit and from the standpoint of fire risk the entire electrical installation is most admirably carried out. The extensive use of armored conduit was a wise precaution in view of the high voltage employed on the motors throughout the establishment.

All the power equipment of the plant was supplied by the Sprague Electric Company through its Boston office, the motors being of the Lundell type. Cutler-Hammer rheostats were freely used and the local contracting firm of Plummer, Howe & Richardson carried out much of the detail work of installation.

The plant is also equipped with a No. 3 A Galley Universal press for job work. There are two No. 6 8-in. by 12-in. Golding job presses, capable each of turning out from 1,000 to 2,700 impressions per hour, 8-in. by 12-in. in maximum size. Each press is driven by a ¼-hp, 500-volt shunt motor, normal speed 7,500 r.p.m. The motors are each mounted on adjustable rails which are set upon a wooden base at one side of the press, the base being set in a galvanized-iron oil pan 17½ in. square. The press is driven by belt, the diameters and faces of the press and motor pulleys being 18 in., 2 in., 3½ in. and 2½ in., respectively. The center to center distance between the pulleys is 20 in. A revolution counter reading up to 100,000 impressions is supplied with each machine. The controlling single-throw, double-pole knife switch for each motor is mounted with the rheostatic speed regulator on a 16-in. by 16-in. by ¾-in. marbleized slate panel bolted to two angle irons 30 in. high, 1 in. wide and ½ in. thick, at the side of the press. The rheostat is of the fan regulating type; it has nine regulating steps, an automatic release coil and a ratchet and pawl attachment on the spindle which enables the operator to set and hold the arm upon any of the contacts for speed adjustment. In passing from the basement to the motor switch the power circuit is carried in a ¾-in. conduit. The wires running to the motor field and armature are carried in a 1¼-in. conduit, the ends being well taped between the end of the pipe and the porcelain connection block on the motor top.

A No. 18 Golding Art Jobber adjoins the two previous machines. It has an hourly capacity of from 500 to 2,200 impressions, 12 in. by 18 in., and is belt-driven by a ½-hp shunt wound motor, whose normal speed is 1,500 r.p.m. The motor pulley has a diameter of 3½ in. and a face of the same dimension; the machine pulley is 19 in. from the motor pulley on centers and has a 24-in. diameter and a 3¾-in. face. The arrangement of the wiring and controlling apparatus is the same as described in the preceding paragraph, and the motor is set up on movable rails in a drip pan similar to the previous one.

The plant is also equipped with a No. 3 A Gally Universal press driven by a belted ⅔-hp round type shunt motor. The press capacity is 750 to 1,650 impressions per hour, 13 in. by 19 in., and the motor speed is 1,450 r.p.m., for 1 hp output and 1,000 r.p.m. for ⅔ hp. The pulleys are 21 in. on centers and have a common face of 3½ in. The press pulley has a 22-in. diameter and the motor pulley 3½ in. The rheostat and switch panel is 20 in. by 15 in. in length and width and the speed controller is of the Cutler-Hammer type, having 10 steps and a ratchet and pawl holding device. The motor is mounted upon the floor in a 17½-in. square drip pan.

There is one No. 2 E Whitlock two-revolution, four-roller press operated by a 3-hp compound-wound round belted type of motor, speed 750 r.p.m. The press capacity is from 1,000 to 2,200 impressions per hour, 25 in. by 38 in., the size of the bed being 29 in. by 42 in. The motor pulley is 5 in. in diameter with 5½-in. face, the corresponding dimensions of the press pulley being 26 in. and 5½ in. Under the press frame is the rheostat and on the frame itself are mounted the main switch and a controller having 15 forward speeds and three reverse points. The wiring for the motor armature and field is carried in a two-inch conduit.

Adjoining the Whitlock press is a two-revolution, four-roller rear delivery Cottrell press, belted to a 4-hp compound-wound motor. Here the motor is mounted upon the lower frame of the press and it has a sliding base with rails for additional belt adjustment. The belt is of the short, wide, endless type, and runs around an idler pulley arranged to guide the belt so as to increase the arc of contact on the motor pulley and to enable the tension to be readily changed. This form of drive possesses considerable advantage as it affords a flexible connection between the motor and the machine, which protects the motor from serious overload, and, should a strain become apparent, slippage will occur between the belt and motor pulley, preventing a disastrous overload from being thrown upon the motor. The pulley dimensions for this drive are:

	Motor.	Idler.	Press.
Diameter	6½ in.	8 in.	30 in.
Face	5½ in.	7 in.	5¼ in.

and the approximate center-to-center distances are: motor pulley to idler, 14 in.; motor to press pulley, 31 in. In this layout the motor occupies no space whatever outside the projected area of the machine on the floor, with the exception of the motor pulley, outboard bearing and idler. The controller is mounted at the side of the frame and besides the usual forward and reverse steps it carries an electrodynamic brake, which automatically stops the press the moment current is cut off from the motor. Between the motor and the rheostat 2-in. conduit is used, ¾-in. main conduit being used to bring the current up from the basement. The main switch is mounted 5 ft. from the floor on the inside of the press frame. The capacity of the press is from 900 to 1,800—52-in. by 36-in. impressions per hour.

Two Miehle two-revolution, four-roller rear delivery presses are also installed, each belt driven by a 3-hp compound-wound motor. Their individual capacity is 900 to 2,200 impressions per hour, 32-in. by 48-in. The controllers for these machines have 15 forward and 3 reverse steps, and the motors are of the belted type, installed beneath the presses. Both pulleys have a 6-in. face, are 26 in. on centers and the motor pulley is 7 in. in diameter, with an 18-in. press pulley.

The paper cutter is a 44-in. Seybold machine, driven by a belted 3-hp shunt motor making 1,400 r.p.m. The switch and starting rheostat are mounted on a panel at the side of the machine. Pulley diameters are 7 in. and 36 in., motor and cutter face 3½ in. The motor is set upon a 21.5-in. square oil pan and the fly-wheel of the cutter is used instead of the regular pulley for belting.

Two Mergenthaler linotype machines are in use at the plant. One of these is a single magazine outfit belt-driven by a special ¼-hp motor, and the other is a double magazine machine driven by a similar ¼-hp motor. Both motors make 1,575 r.p.m. normal speed and the belts are kept tight by the weight of the motors, which are arranged each to hang downward upon a radial bracket free to move up and down.

The advantages of the motor drive in printing press work are so familiar that there is little need to emphasize them here at this time. All the noteworthy features of compactness, cleanliness, saving in power when a press is shut down (as it is about 50 per cent of the time in job work), ease of control and possible economy of operation are apparent in the design of the Blanchard plant. In four of the presses the ratio of floor space occupied by the press and the motor was:

Golding Jobber	3½	motor 1
Golding Art Jobber	4	motor 1
Universal Jobber	6.7	motor 1
Whitlock Press	18.4	motor 1

It is significant that as the size of the press increases the relative amount of floor space required by the motor decreases, until in the larger presses the motors are accommodated within the frame and share the floor space in common with the driven machines.

The Mercury Arc Lamp and Rectifier.

BY E. WEINTRAUB, PH.D.

IN what follows article I shall give an outline of work done in the Research Laboratory of the General Electric Company during the course of the last few years, on the arc discharge in metallic vapors in general, and in mercury vapor in particular. The subject has been treated by me in a paper recently read before the American Electrochemical Society, and here I intend to give more details as to the practical side of the work. The main practical results of the investigation are, first, a mercury arc lamp with a special starting device, based on a new principle which makes the starting of the lamp as easy and automatic as that of an ordinary arc lamp or an incandescent lamp, and which enables the lamp to be used on constant potential as well as constant current circuits (series lighting); second, a mercury arc rectifier for alternating current which can be used for rectification with both high voltage and large current. The introduction contains a brief recapitulation of the history of the mercury arc and of the state of the art at the time when these investigations were started.

HISTORICAL.

The idea of using the spark or arc formed when the circuit is interupted between one mercury electrode and another metallic electrode of suitable material, as a source of light, was the basis of patents granted to a number of inventors in the fifties. I mention the names of Binks (1853, Eng. Pat. 119), Thomas Way (1861, U. S. 33458), E. H. Jackson (Eng. Pat. 40330). To a somewhat later period belong the patents of Olan (U. S. Patents), Riset (French Patent 13,428, 1879), Prosser (Eng. Patent 3,446, 1875), Siemens, Chs. (Eng. Pat. 261, 1867), etc. In most of these patents the arc is formed in air or nitrogen (Riset), and in the better arrangements the arc is produced by allowing a thin stream of mercury to flow from a mercury reservoir, which serves as one electrode, to another electrode made of different suitable conducting materials. The mercury in the stream is vaporized by the heat, generated by the current, and an arc is formed. An arc in mercury vapors in an exhausted space is the object of a patent granted to Rapieff, in which a lamp of the U-form is described, the arc being formed by shaking.

The mercury arc in a vacuum was made the subject of an extended study by Arons (*Ann. d. Physik,* 58, 1896). The influence of different factors on the arc, the connection between current and potential, etc., were carefully determined. For the purpose of starting the arc Arons used two methods:

First, the "contact" method, which consists in bringing the two electrodes into preliminary contact and then separating them. This method is similar to the one used in the case of the carbon arc and the flame arcs. It is the method used by all the earlier investigators who worked with mercury arcs in air. I myself used it before I found the new starting method, and Cooper Hewitt, in the lamps that he now builds, has returned to this method.

Second, the high potential method. In this method a high voltage is impressed upon the tube for an instant, which causes a Geissler discharge through the trace of gas or vapor present in the tube. This makes the space between the electrodes conductive and allows the starting of the arc. Arons constructed a lamp which was used quite extensively by different scientists for various purposes (Gumlich, Summer, Lummer, Paschen, Le Chatelier, etc.).

Jamin and Manoeuvrier found, as early as 1882, that an alternating voltage could maintain an arc between one mercury electrode and another of carbon, and that rectification of the current took place.

Besides the work of Arons, there were a number of patents granted to Peter Cooper Hewitt in which different ways are described for producing the high-voltage shock necessary for the starting of the arc (Wehnelt interrupter, starting band, addition to the mercury of material, such as sulphur, etc.).

From what precedes it will be seen that the following main problems had to be solved at that time:

1. The invention of a new method for starting the mercury arc which would not involve the use of high-potential and complicated arrangements, would start the lamp automatically and allow its use in series lighting.

2. A more exhaustive study of the arc and of the conditions influencing its stability.

3. Construction of a lamp which would run from an alternating-current source. The attempts to solve this problem led me to the invention of the mercury arc rectifier.

THE NEW METHOD FOR STARTING THE MERCURY ARC.—1. PRINCIPLE.

The new method for starting the arc in mercury vapors in an exhausted space invented by me in the course of this work is based on the principle that when a small arc or spark is formed by some auxiliary means at the surface of the cathode an emanation of conductive vapor is projected from the surface of the cathode into the tube, reaches the anode and establishes a path along which the regular arc is established. When the production of current carrying particles is started on the cathode it goes on as long as the energy necessary for the ionization is supplied.

2. THE SIDEBRANCH LAMP.

A simple form of lamp built according to this principle is shown in Fig. 1. K is connected to the negative pole of the source of direct current, B and A to the positive, A through the resistance, r, which serves to regulate the current, and B through a large resistance. By shaking or slightly tilting the lamp the arc KB is started, whereupon, according to the principle stated above, the main arc, K, starts up. The switch in the line leading to B can then be opened.

This starting device does not require any higher voltage than that necessary for the stable running of the lamp. As the voltage across the mercury arc is lower during the first few seconds than afterwards, it is even possible to start the lamp by means of a voltage which is lower than that necessary for its permanent running.

The conditions necessary for the instantaneous starting of the lamp are an exceedingly high degree of exhaustion and certain details of construction. The lamp must be so constructed that the flow of ions from the cathode toward the anode is not too much impeded by obstacles, such as the walls of the tube, etc. Tubes of a capillary bore cannot for this reason be started by this method. This is due to the de-ionizing effect of solid bodies, observed by previous investigators in the case of gases ionized by an exterior agent. Sharp bends in the tube, which force the ionic rays projected from the cathode to often change their direction, hinder, by the de-ionizing effect which takes place at the impact of the ionized vapor against the walls, the starting of the arc, making it often impossible. As the ionized vapor is projected at the moment of starting from the cathode in an upward direction this last remark is especially true when, by the construction of a tube, the ionized vapor is forced to move first upwards against the wall of the tube and then downwards before it can reach the anodes. Fortunately, the tubes required for practical service are of simple shape, so that the limitations of the starting method are of no importance. The shape given to the lamp is generally that of a vertical tube or of a horizontal tube slightly inclined.

More important yet than the shape of the tube is the degree of exhaustion. The starting is instantaneous only when the tube is exhausted to as high a degree of vacuum as possible, and all the gases absorbed in the anode or on the walls of the tube are driven out by heating the tube from outside and by allowing an arc to run inside the tube for a long time during the exhaustion. With a bad vacuum the starting does not take place.

The lamp starts more easily when the tube is at room temperature than when the tube is hot. This influence of inert mercury vapor present in the tube is to be explained in the same way as the influence of foreign gases.

The lamp as described above, therefore, has the following drawbacks: First, while the lamp starts readily when cold or immediately after it is put out (in consequence of the persistence of the ionization in the vapor) there is a certain interval of time, especially in the case of long tubes, when the starting is uncertain. Second, as it is impossible to expel all the gases from the anode and the wall of the tube the vacuum in the lamps deteriorates with use, so that the instantaneous starting of the lamp may not take place after the lamp has been in use for some time.

Notwithstanding, therefore, the theoretical interest attached to this starting method, it would probably never have become of practical importance, except in the case of short tubes, had not an improvement overcome the difficulties mentioned above.

This improvement consists of a carbon filament of high resistance, suspended from the anode and having its lower end not very distant from the mercury cathode. At the moment of starting the presence of this filament means an actual shortening of the tube. After the arc has started the carbon filament is, however, short-circuited by the arc and carries but an insignificant current. The carbon

filament cannot be replaced by any metallic wire for the reasons that the metallic wire, becoming anode for an instant before the main arc develops, melts away, even if it is made of platinum; and the resistance of the metallic wire is altogether too low to be used for this purpose.

The sidebranch lamp, provided with a carbon filament, as described above, starts up at any time and is not as susceptible to a slight deterioration of vacuum as one without filament.

Fig. 2 represents such a lamp, with some additional parts, which permit the automatic formation of the sidebranch arc and cutting out of this arc from the circuit as soon as the main arc starts. *S* is a solenoid, *KH* is an iron core enclosed in a sealed glass tube. The cut-out is at the top. On closing the switch the current flows through the contact in the magnetic cut-out, then through the coil *S* and the mercury surface which connects two mercury cups *A* and *B*. The magnetic action of the solenoid *S* lifts the iron core out of the mercury, whereby the mercury level in *A* is lowered, the surface *EF* broken and the little auxiliary arc formed. As soon as the main arc is started the action of the magnetic cut-out interrupts the auxiliary arc. The auxiliary anode *A* can be made of other material than mercury, for instance, of graphite, and lamps were constructed in which this anode touches the mercury cathode in its normal position and is lifted by magnetic action of the coil (a piece of iron being attached to the anode), thereby causing the auxiliary arc to start. A number of modifications of this sidebranch lamp have been invented, differing, however, only in mechanical details from the main form described above.

3. THE "LIFT-UP" FILAMENT LAMP.

The starting device of this lamp, although its development took place after that of the sidebranch lamp, represents a modified form of the starting device by preliminary contact of the electrodes. The carbon filament of high resistance, instead of reaching within a certain distance of the cathode, is made so long as to dip with its lower end into the mercury cathode. When the switch is closed a slight current therefore flows from the anode along the carbon filament to the cathode. This current is made to flow in a coil which, by its magnetic action, lifts the filament out of the mercury and by interrupting the contact, creates a little arc between the mercury cathode and the lower end of the filament. This arc develops instantaneously into the longer arc between the cathode and the main anode from which the filament is suspended. The arrangements by means of which the filament is lifted differ in different constructions of this type of lamp. In some constructions the filament is suspended inside the lamp from a spring and is lifted by the action of the electro-dynamic contraction of the spires of this spring. In other constructions the filament is suspended from a cylindrical iron shell, which slides along a rod connected to the sealing-in platinum wire. The lifting of the filament is then produced by the action of a solenoid placed outside of the lamp.

Fig. 3 represents a lamp of this construction, with the additional detail that when the filament is lifted the sliding cylindrical iron shell comes in contact with an insulating layer of glass, which covers the rod. This has the purpose of completely cutting the filament out of circuit after the lamp is started. Numerous ingenious modifications of this type of lamp are due to different members of this laboratory, especially to Mr. Whitney, Mr. Wood, Mr. S. Ferguson, Mr. Dempster and others.

Another modification of this type of lamp which is especially noteworthy is due to Dr. C. P. Steinmetz. In this lamp the contact between the carbon filament and the mercury surface is broken, not by lifting the filament, but by lowering the level of the mercury in the cathode.

Fig. 4 illustrates this type of lamp. *K* is an iron plunger, having a depression at its upper part which is filled with mercury. It is this mercury that normally makes contact with the carbon filament. The solenoid *S*, by pulling down this plunger, breaks the contact and produces the little arc which instantly develops into the long one. The operation of the lamp is obvious from the figure.

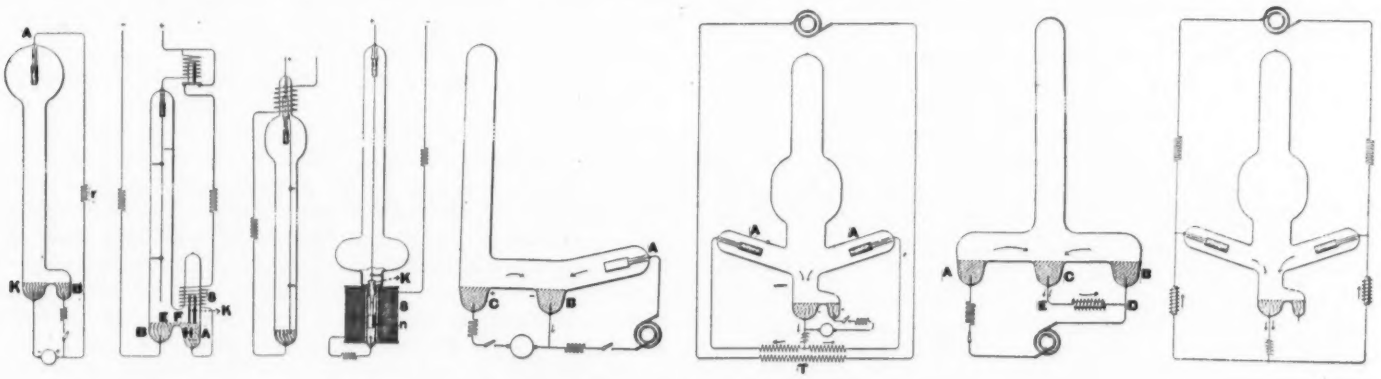
Besides these three main types of lamps, a large number of others have been developed.

The number of these various types of lamps is so large that a complete and detailed description of them would take too much space, without adding to the knowledge of the state of art reached by the principles and constructions given above. The description of the three types given above will therefore suffice, and it will be admitted, I hope, that the problem of starting the mercury arc instantaneously and automatically has been solved in a simple and effective way.

THE MERCURY ARC LAMP AND ITS USE.

In the development of the lamp along the lines described above, a number of engineers of the General Electric Company took active part.

Besides the different types of lamps according to the special form of starting device used, a number of types of lamps were developed according to different other features. To cite an instance, lamps with "top condensing chamber" and "bottom condensing chamber" are distinguished. The first has the condensing space in the neighborhood of the anode, the second in the neighborhood of the cathode. The first type is somewhat more efficient as to light emission, the second is somewhat more stable and preserves better its vacuum.



FIGS. 1 TO 8.—MERCURY ARC LAMP AND RECTIFIER.

The ordinary mercury lamp is termed the "Monochrome" lamp, because of the nature of the light emitted. A type of lamp was developed in which the missing red rays are supplied by incandescent lamps, placed in series with the mercury lamp, the two lights being blended by means of a holophane globe.

The standard lamp in the factory is 16 ins. long, ¾ in to 1 in. in diameter, and works on about 32 volts. The anode is invariably made of artificial graphite. The lamps are used either on constant-potential circuit, say two in series on 110 volts; or on constant-current circuit, a number of lamps in series on a Brush machine; or, as we will see later, on the direct-current side of a mercury arc rectifier connected on its alternating current side to a constant-current transformer.

The average life of the lamp is in the neighborhood of 2000 hours. The efficiency goes down 15 to 20 per cent in the first thousand hours and remains afterwards nearly constant, the discoloration of the glass is the cause of this decrease of efficiency.

Practical tests made in different shops and drafting rooms of the General Electric Company, as well as on the streets of Schenectady, the last mainly by Mr. C. P. Steinmetz, have given very satisfactory results. In the last case the lamps were running for a long time on the circuit of the trolley line, the voltage varying to such an extent that no other illuminant could be used in place of the mercury lamp with nearly as good results.

THE MERCURY ARC RECTIFIER.—I. PRINCIPLE.

The mercury arc rectifier, which, in the course of my researches, I have invented in the Research Laboratory of the General Electric Company, is founded on the principle that current flows in an arc in mercury vapors only so long as the ionization process is going on at the cathode surface. If the ionization process is allowed to die out, even for a very short interval of time, the current flow ceases and the ionization process at the cathode must be started anew. If an alternating electromotive force is, therefore, to maintain a continuous arc in mercury vapors, a mercury electrode must be provided which keeps permanently its negative sign, notwithstanding the continuous change of polarity of the applied electromotive force. The two main methods that I used for this purpose are:

First, an auxiliary direct-current arc, the cathode of which is one of the electrodes of the alternating current. Second, one or more reactances which, by their discharge in the proper direction, keep the cathode alive while the alternating e.m.f. is of the wrong polarity.

2. THE RECTIFIER WITH AUXILIARY DIRECT CURRENT.

In this type (Fig. 5), the tube possesses three cups. *A* and *B* are connected to the alternator, and *B* and *C* to a direct- current source. Under these conditions one half wave of the alternating current passes through the rectifier in the direction *AB*; and the other half wave is suppressed. Combining two rectifiers of this kind allows the use of both half waves, and if Graetz' connections are used, with four tubes, both half waves can be rectified and superposed in the same wire.

Another more simple way of using both half waves has, however, been devised and is represented in Fig. 6. *T* represents a transformer. The ends of the secondary are connected to the two anodes (we call "anode" those electrodes of the rectifier which are anodes of the rectifying arcs).

The neutral wire is connected to the cathode. The current flows in the direction indicated by arrows and the rectified current consists of unidirectional pulsations. The auxiliary direct current, possessing the same cathode, keeps that cathode alive during the time when the current derived from the alternating source is zero or in the neighborhood of zero. This auxiliary direct current can be made very small.

3. THE RECTIFIER BASED ON THE USE OF REACTANCES.

A. The half-wave rectifier (Fig. 7). The half-wave rectifier is described first because it illustrates the principle best. The alternating e.m.f. is applied to the two electrodes, *A* and *B*. The reactance is placed between *B* and *C*. The half wave derived from the alternating current source takes the path *ACD*. The reactance discharges itself in the tube, producing the arc *BC* and filling out by this discharge the interval of time during which the alternating current source has the wrong polarity and cannot maintain an arc with a cathode *C*. The uni-directional current flows in the wire *CE*.

B. The complete rectifier (Fig. 8.) It is sufficient to make the above-described arrangement symmetrical by the use of two reactances to allow the rectification of both half waves and their superposition in the same wire. This arrangement is shown on Fig. 8. The mode of operation of the rectifier and the working of the reactances would be clear from what I said under (*A*). This is the form of the rectifier which is used in most cases and was developed commercially.

4. POLYPHASE RECTIFIER.

The application of the principles stated above to the rectification of polyphase currents is so obvious that I will not dwell upon it to any length. For three-phase current, three anodes are provided in the tube and reactances are inserted between the cathode and each anode respectively. The rectified current flows in the wire, connecting the cathode to the point where the three reactances are joined together.

DEVELOPMENT OF THE SINGLE-PHASE MERCURY ARC RECTIFIER.

The single-phase mercury arc rectifier is being manufactured in three sizes, giving 10, 20 and 30 amp. direct current, respectively; 30 amperes is by no means the maximum current that can be taken from the rectifier. Theoretically, this current has no limit. In practical work one has, however, to contend with the difficulties of introducing large currents into an exhausted glass vessel and of dissipating the energy wasted in the form of heat in the rectifier itself. These difficulties can be overcome in different ways and rectifiers have been built with a capacity of 100 amperes and more.

While theoretically no limit exists for the current, there evidently must exist a limit to the voltage which can be safely rectified by means of a rectifier, especially if large currents are to be derived. The alternating e.m.f. is applied in the rectifiers of this type directly (or else by means of an interposed resistance or reactance) to two electrodes placed inside of an arc. It can be assumed with a great degree of probability that a slight leakage current flows between the two electrodes and that this slight leakage increases with the applied voltage. Under certain conditions this small discharge develops into an arc discharge between the two electrodes, a phe-

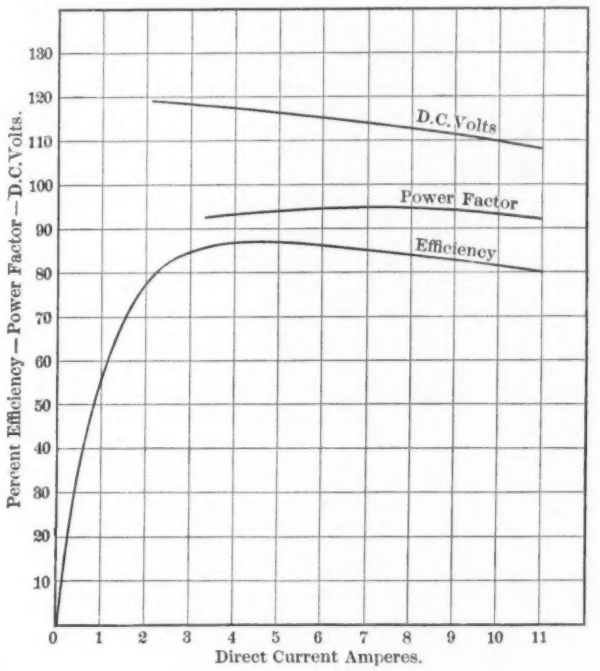


FIG. 9.—CHARACTERISTICS OF 10-AMP. RECTIFIER.

nomenon that is called in our laboratory "arcing of the rectifier." The arcing takes place the more readily the higher the voltage applied. It took long study and a great amount of experimental work by my collaborator, Dr. Kruh, and myself, to differentiate the factors influencing the arcing. As a result, rectifiers are being built for as high as 25,000 volts alternating, delivering a constant current of 6.6 amperes. A rectifier giving 2000 volts on the direct-current

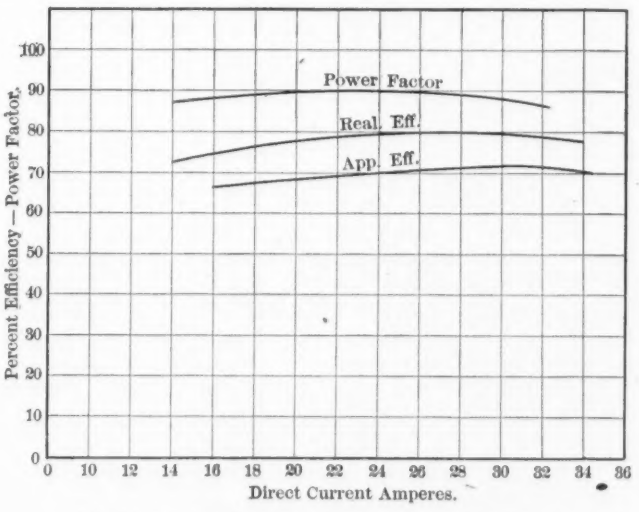


FIG. 10.—CHARACTERISTICS OF 30-AMP. RECTIFIER.

side, with a load of arc lamps is in regular service on the streets of Schenectady, running a number of "magnetite" arc lamps in series.

The commercial development of this system is due to the greater part to Dr. C. P. Steinmetz and the Lynn engineers of the company. Mercury arc lamps are also used as a load on the direct current side of the high voltage mercury arc rectifier. This use of the rectifier can be considered as the greatest technical achievement of the work on the mercury arc.

The efficiency of the rectifier increases with increase in the voltage to be rectified. The loss in the rectifier itself is equal to the product

of a practically constant quantity, the voltage across the arc (15 to 20 volts) into the current. To this must be added the losses in the reactance.

The power factor can be made, by a judicious choice of reactances, higher than 90 per cent. Curves giving efficiency and power of the rectifier under different conditions are annexed.

The starting of the rectifier is done either by an auxiliary direct current (which, in case the rectifier is used for charging storage batteries, is derived from the storage battery to be charged), or else from the alternating current side, using the little auxiliary electrode

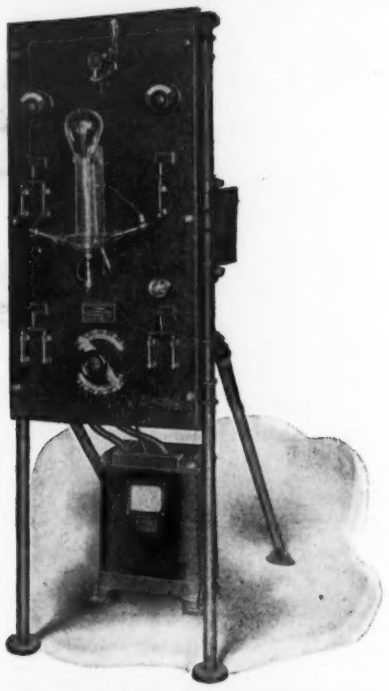


FIG. 11.—MERCURY ARC RECTIFIER CHARGING PANEL.

shown in Fig. 8 as one of the anodes and starting the tube by shaking.

The rectifiers can be used in series or in multiple. In the latter case additional separate reactances must be placed in the circuit of each rectifier.

The commercial development of the single-phase, constant-potential mercury arc rectifier is in the hands of Mr. Samuel Ferguson, to whom is also due the development of the panel shown in Fig. 11. The connections and the function of different parts are clear in themselves and are easily followed out on the diagram of connections shown in Fig. 12.

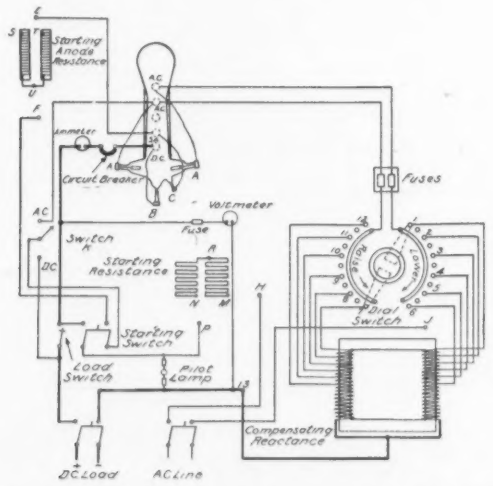


FIG. 12.—DIAGRAM OF CONNECTIONS OF RECTIFIER SHOWN IN FIG. 11.

The rectifier is now extensively used for a number of purposes instead of the motor-generator set, especially for charging storage batteries. It is interesting to remark that in contradistinction to the motor-generator, the efficiency of the rectifier is the same at partial load as it is on full load.

THE STABILITY OF THE ARC.

The conditions of stability of the mercury arc and the influence of exterior conditions on it were the subject of a long study by me and my co-workers, and the main results are given in an article that I published in the *Philosophical Magazine* a year ago, and partly in my recent paper before the American Electrochemical Society, which has been printed in abstract in these columns. Not to make this article too long, I will refer the reader to these articles for the details.

Note on the Use of White Walls in a Photometric Laboratory.

By Edward P. Hyde, *U. S. Bureau of Standards.*

IT is usually considered by photometricians that one of the essential requisites for accurate work in photometry is that the walls of the photometer room be made as nearly "dead black" as possible. It is surprising how long this tradition of photometry has persisted, particularly as it necessitates the exclusive use of a room for photometric measurements, since a room blackened in the customary manner is unfit for any other work. Perhaps it is due to this fact that one so often finds the photometric laboratory in a small room in the basement or garret, or some other place that is unsuited for any other purpose. In all open-flame work, however, much larger errors may result from poor ventilation in a small room than from light reflected from white walls of a larger room, provided a proper set of screening diaphragms is used.

So far as I know nothing has been published as to the magnitude of the error due to white walls when the photometer is protected by black diaphragms, although this arrangement is at present in use to some extent in the photometric laboratory of the Physikalisch-Technische Reichsanstalt of Germany.

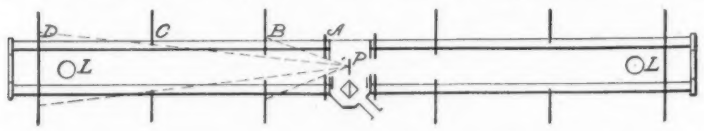


FIG. 1.—HORIZONTAL SECTION THROUGH CENTRE OF PHOTOMETER SCREEN.

In the photometric laboratory of the Bureau of Standards the walls of one of the rooms which is about 29 feet long, 19 feet wide, and 12 feet high, were left white for a year after the construction of the building. Recently they have been given a light terra cotta finish for decorative purposes, but the following measurements were made while the walls were still white. The photometer is placed near the middle of the room and is supplied with a set of diaphragms covered with black velvet. These diaphragms may be so arranged for any position on the bar that no light, except that reflected from the lamps under test, or from the diaphragms themselves, can reach the photometer screen, as shown by the accompanying sketches. Fig. 1 is a horizontal section of the photometer through the centre of the Lummer-Brodhun sight-box, showing the arrangement of diaphragms *A, B, C* and *D*. Elevations of these diaphragms perpendicular to the axis of the photometer are given in Fig. 2. By reference to Fig. 1 it is seen than an eye placed at *P* could see nothing but black velvet diaphragms and the lamps under test. Conversely, no light could reach the screen except from the lamps or from the diaphragms.

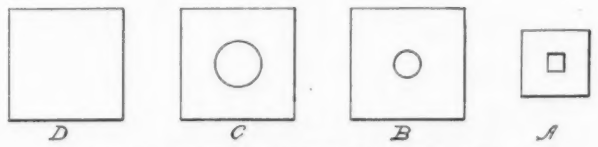


FIG. 2.—FRONT ELEVATION OF DIAPHRAGM.

In case a Bunsen or Leeson disc is used, extra precautions would have to be taken to prevent light from penetrating to the screen from the front of the box. It is essential that this condition be fulfilled if the walls are to be left white, as any reflected light reaching the screen directly would materially affect the result. Furthermore, it is desirable that all outside light be excluded by the use of dark curtains, as under these circumstances the only light

that can reach the photometer screen, apart from the direct light from the lamps, is that part of the light from the two lamps which is reflected by the walls back to the two lamps and to the diaphragms, and from them to the photometer screen.

In order to determine the magnitude of the errors resulting from this reflected light from the white walls of the photometer room of the Bureau of Standards, the measurements described below were made. The results of these measurements show conclusively that the error is entirely negligible.

Before giving the results of the measurements, it may be well to say a word or two in regard to the method of measurement employed at the Bureau in the comparison of incandescent lamp standards. On the carriage on the right side of the photometer is placed a well-seasoned incandescent lamp, though not ordinarily a standard. This lamp is raised to such a voltage that its color is approximately the same as the color of the lamps to be compared on the other side of the photometer, and it is kept at this voltage throughout the test. The carriage on which this comparison lamp is mounted is then rigidly connected by means of adjustable links to the carriage on which the photometer screen is mounted, and at a suitable distance to produce the desired illumination of the screen. The standard is then mounted on the carriage on the left side of the photometer, and is placed at such a position as to give a balance with the photometer at approximately the middle of the bar. The standard is brought to the proper voltage and several readings are taken. The lamps to be standardized are then mounted successively on the same carriage and readings are made. At the end the standard is again measured. If the lamps that are compared with the standard are of the same nominal candle-power as the standard, the left-hand carriage is kept at the same position on the bar. If the lamps are of a different nominal value, the left-hand carriage is always placed so that the balance comes at about the same place on the bar.

This method of measurement, which is a substitution method, has many advantages in accurate work. It eliminates all dissymmetry on the two sides of the photometer, and thus avoids the necessity of reversing the photometer screen.

In making the measurements of the effect of reflection from the walls, the right side of the photometer was entirely protected from reflected light from the walls by large screens which nearly surrounded that half of the photometer bar, so that when the left side of the Lummer-Brodhun sight-box was closed by a shutter, no illumination was visible in the eye-piece. The velvet-covered diaphragms and the lamp on the left side of the photometer, on the contrary, were left exposed to the reflected light from the walls, as in the ordinary method of measurement, except that the lamp on that side was not burning. Therefore the only light that penetrated to the screen was that which, reflected from the walls, fell upon the lamp and black velvet diaphragms and was reflected by them to the screen.

In order that the walls should be illuminated to the same extent as in the ordinary measurements, a 16-cp lamp was burned near the position of the comparison lamp, and another lamp was burned near the position of the standard lamp, but so shielded in each case that no direct light could reach the photometer. The lamp on the left near the unburned standard was changed from time to time from a 32-cp lamp to a 16-cp lamp, depending upon whether a 32-cp unburned lamp was in the left socket at the distance from the screen at which a 32-cp lamp is usually placed, or a 16-cp lamp was in the socket at the position used with a 16-cp lamp. These precautions were taken in order to have the conditions as nearly like the actual conditions as possible.

Under these circumstances it was perfectly plain, on looking into the eye-piece of the photometer, that the left side of the sight-field was slightly illuminated, and it only remained to measure this illumination under the different conditions likely to occur. To this end a 1-cp lamp, which had been placed on the carriage on the right in the position of the comparison lamp, was brought to incandescence, and the light from this lamp was cut down by absorption strips of smoked glass, having known coefficients of transmission. Thus, successive absorption strips were added until a balance was obtained, and the number of strips and the positions of the three carriages were recorded.

This method of procedure was followed through a great number of measurements, the conditions being changed from time to time until all the conditions that are actually encountered were included, in order to determine whether any error due to the walls could possibly be introduced in any comparisons that are ever made. What was actually measured each time, of course, was the illumination of the screen due to the reflected light, and it was merely a matter of computation to determine what the candle-power at any distance would be in order to produce the illumination found.

I shall not give the results of all the measurements that were made, but merely indicate the results for two typical cases, which show clearly the order of magnitude of the effect. First, from the direct measurement of the illumination that was produced when a 32-cp standard (not burning) was placed at the position at which a 32-cp lamp is generally placed in standard measurements, and another 32-cp lamp was illuminating the walls, calculation showed that the illumination on the screen, due to the reflection from the walls, was that which would be produced by a source of 0.003 candle at the position of the 32-cp standard. In a similar way the correction to a 16-cp lamp was found to be about 0.001 or 0.002 candle. Thus, we see that not only would the relative error in comparing a 16-cp lamp with a 32-cp lamp be negligible, but that the absolute error for either one would be negligible in the most refined measurements, being of the order of magnitude of one part in ten thousand. To be sure, the determination of this correction may be considerably in error, but, since the correction is so very small, it could be increased to several times its value, and still be beyond recognition.

All of these measurements were made with the windows covered with heavy curtains, the only sources of illumination of the walls being lamps similar to ones that would ordinarily illuminate the walls when making photometric measurements. When the curtains were raised the effect was greatly increased, so that the error in a 32-cp lamp was several tenths of a candle, varying with the brightness of the sky and with the distribution of objects about the room. Approximately the same relative error was found for the 16-cp lamp, so that in comparative measurements the errors in general would be negligible, but since the errors of measurement of these corrections were necessarily large, and since we found the corrections to vary considerably when an observer moved in front of a window, it is desirable to exclude daylight by curtains, as there is a possibility of error even in comparative measurements with the substitution method when such large absolute errors occur.

In conclusion, I desire to express my indebtedness to Mr. F. E. Cady for valuable assistance in making the observations.

The Trolley in Calcutta, India.

One of the largest and most successful trolley systems ever installed in the Far East is that in operation at Calcutta, India, a city with a population of about 1,250,000, of which barely one per cent is European. The system was originally carried on with horses and steam, but a new concession was obtained from the city authorities for thirty years from January 1, 1901, on condition of adopting electricity. The first electric line went into operation in March, 1902, and by November of the same year the entire change had been made. The result has been an increase in traffic of 75 per cent in the two years. The company makes a handsome return upon its capital stock of $3,500,000 and pays 4½ per cent on a $1,750,000 debenture issue.

The electrification of the system was carried out according to the most modern plans in everything as regards central station equipment, overhead and underground conducting system, rolling stock, etc., and especial attention in design was given to adopt the plant to the peculiarities of tropical and local conditions. The engineers and contractors were Dick, Kerr & Co., Limited, of London and Preston, for all work except the buildings and the reconstruction of the track, which was carried out by the company itself. All the rails, iron work, bonds, etc., for the permanent way work were, however, furnished by Dick, Kerr & Co. The entire conversion was creditably carried through in a comparatively short time, and the various parts of the plant have since then worked well under the most trying conditions. The present tramway routes cover a total length of 25 miles, double track throughout.

The car service, or rather train service, regulated carefully according to requirements, begins at 5 a.m. and ends at 10.30 p.m. The native being an early riser, traffic begins quite briskly in the morning, takes a sudden rise at 9.30 to 11 a.m. during the office traffic, falls off during the afternoon, increases rapidly again at 4.30 for the return office traffic, and is practically finished at 9.30 in

the evening, since the native travels about but very little at night. The maximum number of trains operated at one time during an ordinary week day, on the present 46 miles of single track, is 132. This is increased to 145 on race days, and during the recent Pujah festival of the Hindus (corresponding to our Christmas in import-

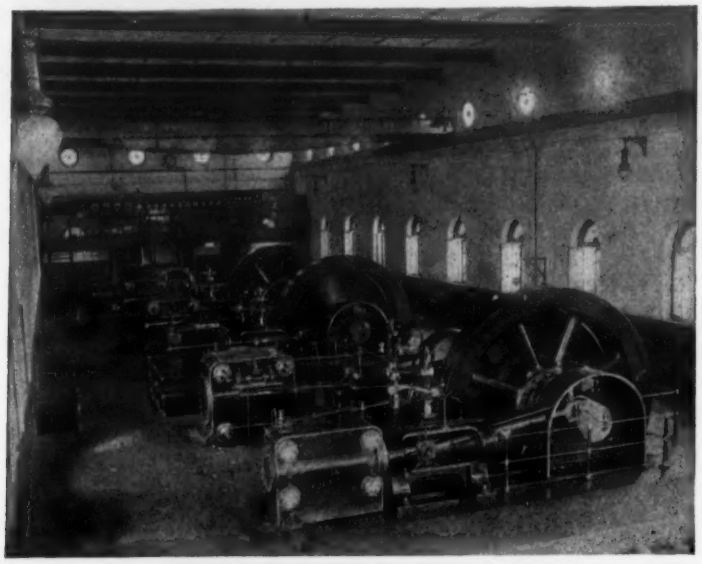


FIG. 1.—INTERIOR OF NONAPUKUR POWER HOUSE.

ance), the then full equipment of 151 trains was required. During this time the traffic to the temple at Kalighat, from all parts of the city, was very large. Although there are well recognized fixed stopping places on the system, it has not been found practicable to make use of them exclusively, on account of the very severe conditions of heat and rain, which make it necessary for the comfort of passengers to set them down and pick them up wherever they may require. The total number of passengers carried per year is 21,000,000. The total yearly train miles are 3,300,000. All the employes handling this traffic and the entire plant are natives except the superintendent and his two first assistants.

On converting from horse to electric traction, it was decided to adopt the train system, consisting of one motor and one trailer car, the former serving first-class passengers, represented by Europeans and well-to-do natives, who previously never made use of the tramways, and the latter providing accommodation for the old patrons. This system made it necessary to construct loops or triangles at various points of the lines for the turning of the trains. At present there are 171 single-deck motor cars, of which 96 are of the open type and 75 of the closed type. The motor equipments were made at the Preston works of Dick, Kerr & Co., Limited. The car bodies were supplied by the Electric Tramway & Railway Carriage Works, Preston, and the trucks were furnished by J. G. Brill & Co. The car bodies are of plain, strong construction, made to suit the climatic conditions. Teakwood is used throughout, as being impervious to the ravages of white ants. The closed cars have a total seating capacity of twenty-seven. The open type cars, which have a seating capacity of forty passengers, are single-ended, with the entrance

FIG. 3.—DALHOUSIE SQUARE, WEST; POST OFFICE ON RIGHT.

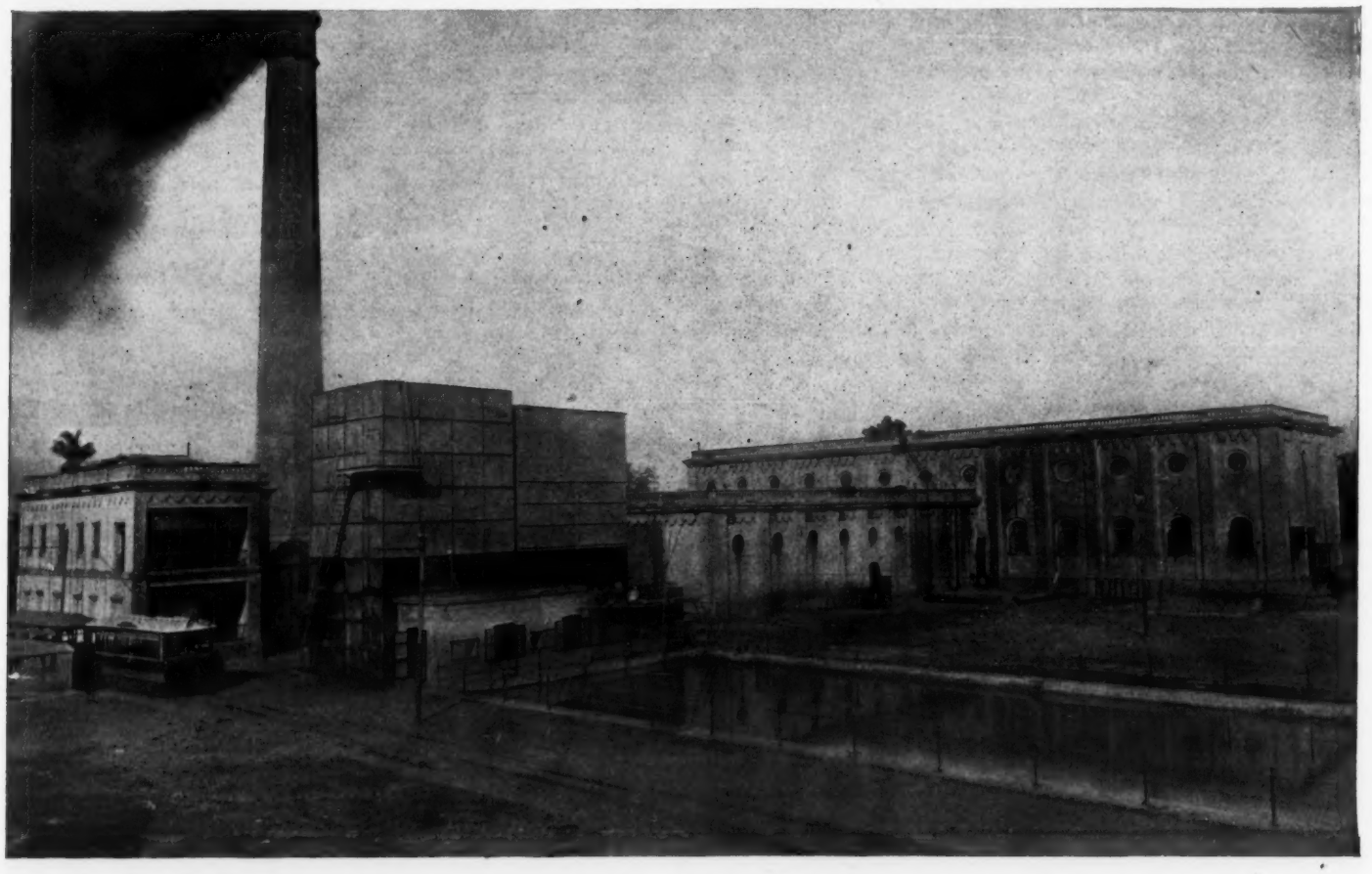


FIG. 2.—EXTERIOR OF NONAPUKUR STATION.

from one side only, this being dictated by the loop system that was adopted.

The electrical equipment for each car, as manufactured by Dick, Kerr & Co., consists of two motors, with one controller and all accessories. Each motor has a normal output of 25 hp under the standard rating. It might be pointed out that the motors have had to stand very severe operating conditions, due to the heavy rains, which, during the rainy season, flood certain parts of the city to a depth of several feet, as already mentioned above.

Views are given here of the exterior and interior of the power

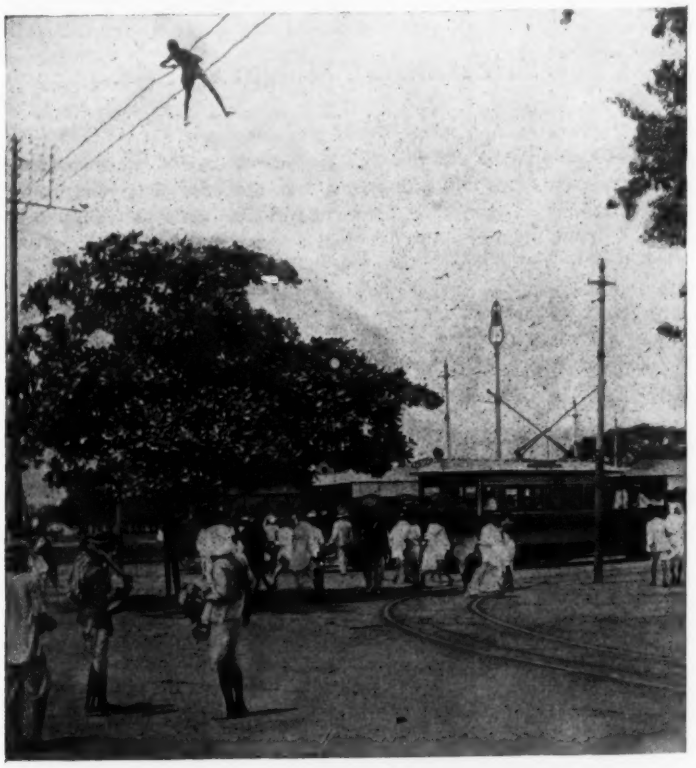


FIG. 4.—JUNCTION AND LOOPS, CHOWRINGHEE ROAD.

house. The main items of the equipment are three 500-kw Dick-Kerr direct-current generators. To provide sufficient power for additional trains which will have to be run to cope with the steadily increasing traffic demands on the existing lines, and also for the service on several new suburban lines which will be opened in the near future, the power station is being considerably increased. Three-phase, alternating-current generators are being installed, generating 6,600 volts direct, and the current will be transmitted to several rotary converter sub-stations in outlying parts of the city by means of duplicate three-core cables laid separately on the solid system in earthenware troughing.

New Telephone Patents.

SWITCHBOARD CONNECTING CORD.

To Messrs. C. L. Burlingham and W. J. Burton have been granted two patents which cover a new form of flexible switchboard connecting cord. The foundation is a closely wound spiral spring which forms a resilient rod. About this in a close spiral of as many strands as there are conductors to be taken care of are wound the separately insulated conductors. A digression has been made from earlier practice in these, for instead of a tinsel rope the conductors consist of a piano wire of steel covered with a fine copper wire. The cord is finished with the usual linen braidings.

INTERCOMMUNICATING SYSTEM.

In a patent issued to A. K. Andriano, of San Francisco, there is described what the inventor calls a "direct line" intercommunicating system. In this system, as usual, there is one wire from each station tapped into every other, but all talking is done over individually paired lines. The means of accomplishing this result is best understood in connection with the method of operation. Suppose No. 1 wishes to call No. 6. He will set the switch to line No. 6 and ring up. Six in responding learns who called not by inspection or by inquiry, but by hunting out the calling station on his auxiliary switch. To this end he passes its arm over the contact dial and as he reaches the proper contact he is signaled. Both stations must return the switch arms upon the completion of a conversation in order to clear the lines.

RINGER BOX FOR SUBSCRIBERS' SETS.

There is described in a recent patent which has been granted to Henry W. Crane, of New York, a very interesting ringer box for

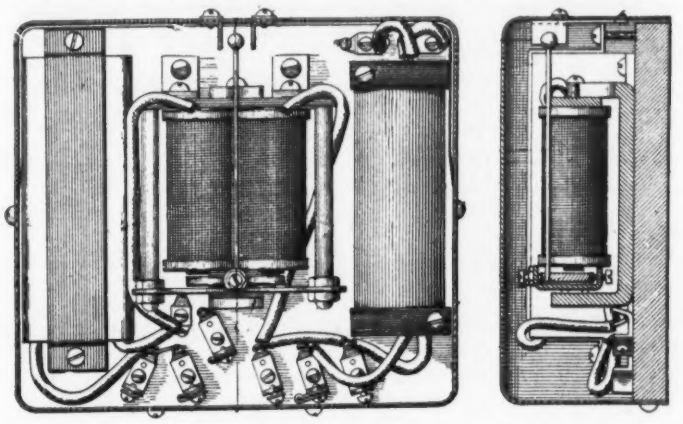


FIG. 1.—CRANE RINGER BOX.

telephone stations, which is indicated in section in Fig. 1. In this the usual gongs are done away with, the sheet metal cover of the box serving in their stead. A baseboard, with the top and upper sides slightly cut away, carries the ringer and induction coil, and where necessary the condenser. Over this fits a thin sheet metal cover which grips and is securely fastened to the bottom and lower side edges of the base, but which clears the cut-away portion. This cover carries upon one end two inwardly projecting ears upon which the bell tapper strikes, the metal cover serving as a resonator to give out loud sounds. The ears are preferably made adjustable, just as are the gongs of the usual bell. The Western Electric Company has been assigned Mr. Crane's patent.

SELF-RESTORING DROP.

In Fig. 2 is shown another combined jack and drop, of which so many have been appearing recently. With this apparatus the restoration of the drop shutter is linked with the insertion of the plug,

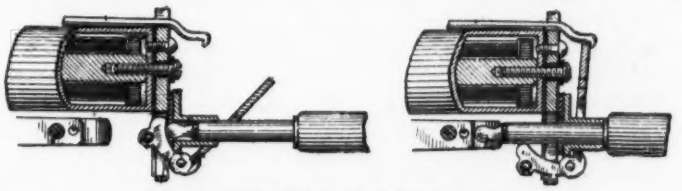


FIG. 2.—TIDEMAN SELF-RESTORING DROP.

through mechanical means, which will be understood from the illustration. Mr. H. Tideman, of Menominee, Mich., is the inventor of this device.

TELEPHONE SUPPORT.

A receiver support, consisting of lazy tongs with stiff joints, has been patented by Alice McSweeney, of Crafton, Pa. The stationary point of the lazy tongs is a ball and socket joint with a setscrew. The apparatus is so designed and placed that the receiver may be returned to the hook in the usual manner.

LETTERS TO THE EDITORS.

The Law of Plunger Electromagnets.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with the greatest interest Mr. Underhill's article on "The Law or Plunger Electromagnets" in the issue of your paper for May 20, and agree perfectly with the author that the pull between the plunger and the "stop," and the pull between the plunger and the coil are to be considered separately. In using Maxwell's formula, $P = \frac{B^2}{8\pi}$, where B is induction per sq. cm., and P is pull

in dynes per sq. cm., we include tacitly the pull between plunger and coil, as may be seen from the following calculation:

$$B = H + 4\pi I, \text{ } I \text{ being the intensity of magnetization,}$$
$$B^2 = H^2 + 8\pi H I + 16\pi^2 I^2,$$
$$P = \frac{B^2}{8\pi} = \frac{H^2}{8\pi} + H I + 2\pi I^2.$$

The total pull consists, therefore, of three parts, which may be interpreted in the following way:

(1) $2\pi I^2$, the pure magnetic pull between the magnetic masses of opposite polarity on the plunger and the stop. This would be the only pull exerted in the case of permanent magnets.

(2) $H I$, the electromagnetic pull between the pole of the plunger and the magnetizing field of the solenoid.

(3) $\frac{H^2}{8\pi}$, the electrodynamic pull between the lower and upper half of the solenoid windings. This part of the pull cannot be utilized when the solenoid is stationary and is wound as a whole.

As to the expression $2\pi I^2$ for the magnetic pull, it may be remarked that it holds good only in cases where the air-gap between plunger and stop is very small in comparison with the diameter of the plunger. For wide air-gaps the above-mentioned term is subject to a considerable change, and for very wide air-gaps Coulomb's law, $P = \frac{I^2}{l^2}$, where l = distance of the poles, must be applied.

CHICAGO, ILL. FRED MEURER.

The Design of Motors.

To the Editors of Electrical World and Engineer:

SIRS:—It seems to the writer that it would be better for the world at large, and for the electric business in particular, if one branch of the art would become familiar with the other. What I have in mind here is the designer of electric motors and the contractor. An example from actual practice will serve as an illustration. A 15-hp motor made by a well-known company, is delivered at the premises all boxed in, and the wireman is told to atach it to a printing press. For want of room, he knocks the boxing off and drags the motor from its box skids. Since the base of the box is too wide for the space through which the motor must pass, the skids must be removed.

In this connection it may be remarked that another prominent manufacturer puts machine bolts through the skids from below into the machine, in which case the skids must be raised high enough to allow the drawing out of the bolts, or the machine must be rolled over on its side.

The wireman now finds that, since the motor has four separate legs, he cannot use rollers under it. A crowbar he may not use, either, lest he do damage to the flooring. He and an assistant will have moved the motor in position in about three hours (distance, 10 feet).

When he wants to line up the motor more trouble is encountered. The motor must be placed temporarily without bolting until perfectly in line. The wireman may then mark the holes, drag the motor out of the way again (three feet), drill the holes, push the motor back again and bolt it in place. All of this work is necessary because the holes in the base are so close to the frame of the motor that the man cannot drill them when the motor is in position. When one considers also the fact that the base of the motor is very narrow, making the overhang unduly great, he is much inclined to criticise the designer.

From the point of view of the repairman, I must say that the bottom of motors should always permit the placing of rollers. The designer should remember that the wireman has no traveling crane or its equivalent with him.

The problem cited was a comparatively easy one. A more difficult one arises when the wireman must place this motor on the wall or on the ceiling. The motor has an eye-bolt, but since no holes have been drilled and tapped in the sides or the bottom, it is of no service to him. Of course, he gets it in place, to the despair of the repairman, who finds it still harder to get the motor down again. (Machines do break down.)

I have never seen an outfit which takes in consideration a possible repair, and makes provisions accordingly. A remedy for these troubles would be found in assembling the legs in a part separate from the motor, the legs forming a cradle and the motor a barrel, the binding posts being put on the ends. To mount a motor so built the wireman would set the cradle in place, lay down a few sticks of wood as approaches and roll the motor into it. For wall or ceiling suspension, the cradle would be set first and then the motor would be hoisted into place with two ropes, as a barrel is raised up the cellar stairs.

NEW YORK. PAUL G. TISMER.

Utilization of Niagara Falls.

To the Editors of Electrical World and Engineer:

SIRS:—Apropos the Niagara Falls discussion, which has occupied considered space in the editorial columns of the daily papers for some time past, I would like to suggest the consideration of the question from another point of view.

The power of Niagara Falls has been estimated as over 5,000,000 hp, which at the very conservative price of $10 per hp-year is worth $50,000,000 per year. Thus it is seen that this great natural wonder is costing the U. S. government, and therefore the people of the United States, at least $50,000,000 per annum. Is it worth while? Can we afford to exhaust our coal mines and at the same time pay this enormous sum for the pleasure of a few thousand people, a good share of whom are foreigners? If the government were to build and maintain a great falls in some large city, New York, for instance, where millions instead of thousands, as now, could enjoy it, at the cost of $50,000,000 annually, would not the people of this country raise a great hue and cry? They most certainly would and rightfully, too.

How many people in the United States have ever seen or ever will see the Niagara Falls? I dare say, not one in one thousand, and yet every man, woman and child is paying for the maintenance of this great sight. Beauty uplifts and refines man and should be brought into his daily life. If the government must spend such an amount on beauty, why not do it more efficiently? Why not beautify our cities and their vicinity? Bring beauty within reach of everybody!

I wonder if the women's clubs, which concern themselves so greatly over the destruction of Niagara Falls, have ever realized what coal means to the existence of most of our great cities?

It is inevitable that the day shall come when our coal is gone and we must utilize our water powers. Why wait until we have no coal? Why not save the coal for those industries which cannot get along without it? Assuming that it takes 10 pounds of coal to produce one horse-power-hour, or about 43 tons per horse-power-year, we have the equivalent of 215,000,000 tons of coal going to waste each year. Such figures are enough to set anyone to thinking.

This great water-power is the birthright of the people of the United States and should not be given to private corporations to exploit for their own benefit. If developed by private parties the people, through the government, should receive a rental for the rights.

NEW YORK. O. A. KENYON.

Materials for High-Tension Insulators.

To the Editors of Electrical World and Engineer:

SIRS:—In reading the ELECTRICAL WORLD AND ENGINEER of May 6th I find your editorial on high tension insulators. This article is of special interest to all engineers since it lays before them your views on a subject to which we realize that far too little attention has been given. While in the main I agree with you that, in view of the constantly increasing voltages being used, we must search out the very best materials obtainable for insulating and use only these, yet I find in your article some statements which I realize must be very misleading to the average engineer, and it is to these that I wish to call your attention. As a chemical and ceramic engineer I see these matters from an entirely different point than the electrical engineer, and can possibly throw some light upon disputed points. The average green or white glass in use to-day has a composition of about one unit flux and two and one-half units

silica, which means that it would be classed as a low silicate. All low silicates are more or less apt to deteriorate in time by exposure, some even crystallizing on exposed surfaces. This breaking up of the surface structure creates a resting place for an accumulation of dirt and hence the tendency to spill over, as you state.

If glazes used on porcelain are of as low silicate composition as are the glasses, they also are subject to the same tendency to deteriorate and become rough by long exposure. This is especially true if any lead is used in the composition, since lead silicates are most easily attacked. Hence for insulators a glaze must be used, the composition of which is such that the atmosphere has nothing to attack. The idea prevails that the very smooth glass-like glaze is the most desirable surface covering, but as we are confronted by the fact that to obtain a glass-like surface the glaze must flow, the glaze must be either a very low silicate or contain lead.

We can see at a glance that the electrical engineers are asking for something which in reality they do not want. Furthermore, this glazed surface, due to flowing, has a tendency toward crazing or cracking. What the engineer really wants is a glazed surface to which dust will not attach itself any more than to glass, but without the glass composition and its accompanying deteriorating tendency; and this is exactly what my company—the Locke Insular Company—is prepared to give them. The point which I particularly desire to mention is the fact that porcelain never should depend upon its glaze for puncture strength, nor do any of the porcelains which this company is using to-day. Porcelain can be and is made, right here in our factory, which will stand higher tests unglazed than any glass that we have been able to obtain either imported or domestic. I do not claim that the glaze has no insulating value but, in order to insure a perfect insulator, the glaze should never be depended upon, since there must be portions of the insulators which are, of necessity, left unglazed, and these would be weak points in any vitrified porcelain.

That large pieces of porcelain cannot be successfully vitrified is also erroneous. True, they cannot be properly fired at the same time as smaller or light ware, but we can and do fire very heavy blocks of porcelain and guarantee them to be thoroughly vitrified. The real fault with heavy pieces of porcelain rests in the fact that some interior flaws may exist which the volume of the piece prevents the workman from detecting and correcting. A thin piece of porcelain can be produced with much less danger of flaws, and when present they are apparent, and the piece can be condemned.

The fact that insulating porcelain is as a rule not so white nor so well glazed as fine table ware, is due to the fact that mechanical strength being a factor with insulators, it is very essential that the material be of as fine grain and texture as possible, and this is impossible where only the china clays of the common white ware are used. Furthermore, should electrical porcelain be so compounded that a glassy fracture is obtained, you would have the same inherent weakness or brittleness that you find in your imported china, and which is only more apparent in glass. If porcelain is properly combined and properly fired a test will determine whether it is faulty or not. If it is perfect, I believe it will stand the potential for which it is built for 1 or 1,000 hours. This opinion is reached after an experience covering several years. I have never seen a perfect piece of porcelain that showed any evidence of deterioration from exposure or use. In every case the insulator has been faulty in composition or imperfectly fired. The same is the case with the glaze.

With glass you say a flaw can be detected. Why then do glass insulators so often break completely in two, after months or even years of use, a thing never known with porcelain? It is because a flaw existed which could not be detected and which developed by exposure until too weak to stand the strain placed upon it.

VICTOR, N. Y. ARTHUR S. WATTS.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Eddy Currents in the Armature Iron of Direct-Current Machines.—PICOU.—A mathematical paper read before the International Society of Electricians in Paris. The author points out that in slotted armatures the losses of energy due to eddy currents in the iron have about the same value as the hysteresis losses, at least at full load. The greatest eddy-current loss is produced around the slots of the armature during commutation. The law of their variation with the frequency cannot be expressed simply, and the so-called methods of separating hysteresis losses and eddy-current losses based on the variation with the frequency are certainly not applicable to dynamos with slotted armatures. The author thinks that the eddy-current loss must play an important part in the phenomenon of commutation, and that a theory of the latter must take these losses into account.—*L'Eclairage Elec.*, May 6.

Construction of Small Dynamos.—POOLE.—In a continuation of his serial on the design and construction of small dynamos and motors, the author gives miscellaneous instructions as to details.—*Am. Elec.*, May.

Speed Regulation.—An article illustrated by diagrams on various methods of speed regulation of series-wound and shunt-wound, direct-current motors.—*Elek. Anz.*, May 7, 11.

Synchronizing.—MEADE.—An illustrated description of automatic synchronizing devices.—*Elec. Club Jour.*, May.

LIGHTS AND LIGHTING.

Tantalum Lamp.—SIEDEK.—An account of measurements of the candle-power, watt consumption and economy of standard 110-volt tantalum lamps at different voltages. The measurements were made with a Lummer photometer; they began at 75 volts and were carried upward to 200 volts. The figures are the averages of four lamps. A great difficulty was found in the fact that the light of the tantalum lamp becomes whiter with increasing voltage and differs more and more from the yellow light of the comparison lamp. At about 85 volts the color of the light of the tantalum lamp is equal to that of a carbon filament lamp at normal voltage. Fig. 1 shows the increase of the candle-power with increasing voltage, *C* referring to a carbon filament lamp and *T* to the tantalum lamp. While the carbon filament lamp burned through at 200 volts after 3⅓ minutes, all four of the tantalum lamps stood this voltage easily without burning through.

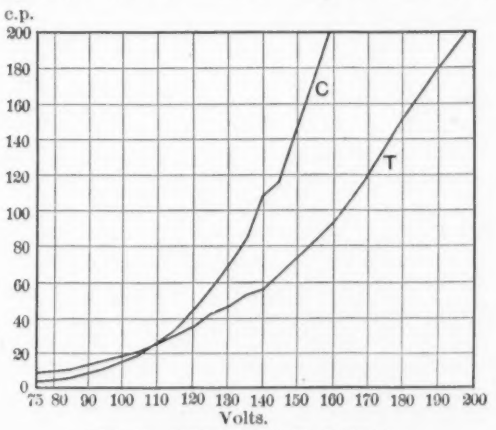


FIG. 1.—CANDLE-POWER CURVES.

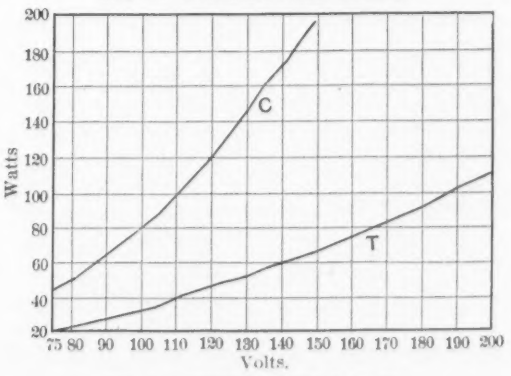


FIG. 2.—CONSUMPTION CURVES.

After the tests the four tantalum lamps showed scarcely any blackening of the globes, while the globe of the carbon filament lamp was considerably blackened. Fig. 2 shows the watt consumption as function of the voltage. Fig. 3 the volt-amperes per candle-power as function of the voltage. These results show that variations of the voltage in the supply network are of considerably less influence on the economy and life of the tantalum lamp than is the case with the

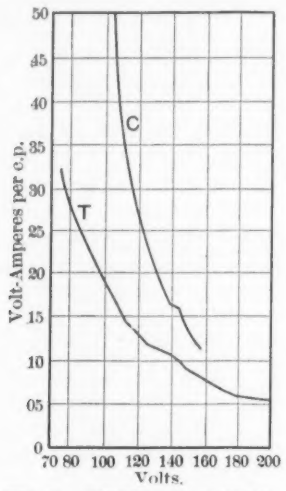


FIG. 3.—WATTS PER CANDLE.

carbon filament lamp. Since the same may be said of the total watt consumption, the life of the tantalum lamp is considerably more independent of variations of the voltage than is the case with the carbon filament lamp. The author thinks that these properties are greatly in favor of the tantalum lamp when used in competition with the carbon filament lamp.—*Zeit. f. Elek.* (Vienna), May 7.

Osmium Lamp.—An illustrated note on the osmium lamp, which is now being put on the market in England by the British General Electric Company. Lamps of 2½ cp are supplied for 4 volts, 5½ cp at 8 volts, 10 cp at 25 and 33 volts, 25 cp at 45 to 60 volts, 32 cp at 70 volts to 75 volts. While Wedding had formerly stated that the average life of the lamp was 1,500 hours, with a consumption starting at 1.4 watts per candle and increasing to 1.8, the company now claims only an average life of "not less than 500 burning hours," and a consumption of 1.5 watts per candle. The following results of tests are given by the company: A 27-cp osmium lamp, after burning 1,333 hours, was found to be giving 23 cp. The initial consumption was 1.42 watts, and at the end 1.6 per candle-power. A 30-cp lamp consuming initially 1.46 watts per cp was giving 24.2 cp at the end of 1,299 hours, the consumption being 1.76 watts per cp, and the same lamp at the end of 3,132 hours was giving 23.7 cp at 1.78 watts per cp. The writer of the article remarks, however, that the disadvantage of the lower voltage should be taken into account as well as the higher price of the osmium lamp. The price varies from $1 in the smaller sizes to $1.87 in the larger ones. "Adapters" are supplied for connecting by a single socket two, three or more osmium lamps in series. The adapters are fitted with a bayonet socket so that they can come into the lamp holders or existing fittings. The cost of the adapters varies from 62 cents for two-way to $1.37 for five-way adapters. The lamps should be burned only in a vertical hanging position. The consumption figures are one-half as large as those for carbon lamps of equal size and life. Several illustrations of different sizes of the commercial osmium lamp and of the adapter are given.—Lond. *Elec.*, May 12.

Fittings.—Illustrated descriptions of plug sockets and connections for incandescent lamps as well as of suspension devices for arc lamps made by German companies.—*Zeit. f. Beleucht.*, April 30.

Fittings.—WATSON.—An illustrated paper read before the Glasgow Section of the British Institution of Electrical Engineers, on electric light fittings and the evolutions of their design.—Lond. *Elec.*, May 12.

Small Batteries.—FAHRIG.—An article on the construction of small batteries for pocket lamps, etc.—*Elek. Anz.*, April 23.

POWER.

Efficiency of Steam Plant.—VIGNOLES.—An article giving results obtained in a British central station. The author gives figures to prove that a steam plant on board a ship shows throughout a far higher efficiency than found in ordinary electricity works. In the tests in his station he found that only 60 per cent of the steam is actually used in driving the engines. The main results are summed up as follows: The average load on a station compared with its capacity is more important than the load factor as usually understood, and in comparing the performance of one station with another this should be taken into account. Where the maximum load approaches the capacity of the station, the load factor will not be very different from the average load divided by the capacity of the plant. The writer calls the latter the "plant load factor" to distinguish it. As mentioned above, in the case of his plant at present 40 per cent of the steam generated is lost or used for auxiliaries, only 60 per cent reaching the engines; the mean load during the quarter year ending September 30, 1904, was 131 kw, the actual steam consumption being 50.6 pounds per unit, and the plant load factor 14.55 per cent. If the average load in the station could be increased to 550 kw—i. e., a "plant load factor" of 61 per cent—the steam consumption would be reduced to about 38.5 pounds per unit, or a saving in steam (and therefore coal) of no less than 24 per cent, whereas, even if the load factor was 100 per cent, the saving in the boiler house due to the improved load factor would not exceed about 3 to 4 per cent. In general the following conclusions may be drawn: First, that the load factor has only a small effect on the pounds of water evaporated per pound of fuel burned. Second, that the steam consumption in a central station equipped with a number of sets, compared with the total load on the dynamos, may be shown by an approximately straight line; in fact, the "Willans Law" for a steam engine is applicable to a central station. Third, that the average steam consumption during any period may be determined by working out the average load, when the consumption can be read from the curve. Fourth, that the load factor does not give sufficient information about the conditions of the load, but that the capacity of the station should be substituted for the maximum load observed in working out the load factor. In an editorial with reference to this article a plea is made for larger units. In the case of Vignoles' station, the total capacity of 900 kw is made up to eight steam dynamos, and the real result of his tests is to emphasize how important an influence the number and size of units has on the economy of generation.—Lond. *Elec.*, April 28.

Italian Power Transmission.—BIGNAMI.—An illustrated description of the power transmission from the Cellina River to Venice. The available power is between 15,600 and 18,900 hp. There will be six large turbines, of which four have already been installed, each of 2,600 hp, direct-connected to three-phase alternators. There are some smaller sets for excitation. The exciting current can be so adjusted as to gradually vary the voltage at the terminals of the alternators from 3,600 to 4,800. For raising the voltage single-phase transformers are used. The power of the transformers has been determined by the capacity of the line they have to feed. As, when the installation is completed, the line will consist of four groups of three conductors, and will have to carry 12,000 kw, each transformer has been designed for a capacity of 1,000 kw, so that each group of three transformers will have to feed a group of three wires. When the installation is completed the working transformers will be 12 in number, and a fifth group of three transformers will be held in reserve, ready to take the place of any of the other groups. The voltage of transmission is 30,000 to 36,000.—Lond. *Elec. Rev.*, April 7.

Electricity in Coal Mines.—A reprint of the special rules which have been issued by the British Home Office for the installation and use of electricity in coal mines, to be observed "as far as is reasonably practicable."—Lond. *Elec. Rev.*, April 14.

Michigan Smelter.—WHITE.—A description of the works of the Michigan Smelting Company, near Houghton. The power plant contains a steam-driven, 200-kw alternator. For supplying the electric locomotives and cranes, the current is converted to direct current by a 100-kw motor-generator. Throughout the plant the endeavor has been made to replace manual labor by machinery.—*Eng'ing and Min. Jour.*, May 4.

Cranes.—HERZOG.—An article, profusely illustrated with detailed drawings, on the construction of electric traveling cranes.—*Zeit. f. Elek.* (Vienna), May 14.

Water Power Plant.—CHURCHILL.—An illustrated description of the new hydro-electric power plant of Cornell University.—*Eng'ing Rec.*, May 20.

Gas Power.—WYER.—Three papers, one on gas producer power plant, the second on the testing of gas producers and the third giving a bibliography of articles and books on gas producers.—*Bi-Monthly Bulletin Am. Inst. Min. Engrs.*, May.

Steam Piping.—STROHM.—An article illustrated by diagrams on the steam piping of a small lighting station. The duplicate system and the system of sectional subdivision are discussed.—*Am. Elec.,* May.

Lathe Work.—SPERRY.—A paper giving the results of observations at the works of the Cincinnati Milling & Machine Company, showing the speeds and feeds at which iron and steel are being machined to-day. The paper is profusely illustrated by diagrams.—*Am. Machinist,* April 25.

TRACTION.

Motor Car for Single-Phase and Direct-Current Traction.—CRONBACH.—An article on tests made by the Allgem. Elek. Ges., of Berlin, with a tramway car which can be operated quite satisfactorily with either continuous or single-phase current. The car is provided with two six-pole, 30-hp, single-phase Winter-Eichberg motors, designed for 550 volts and a frequency of 40 cycles per second. No regulating transformer is used. On starting with single-phase current the stators and rotors of both motors are all in series, but after a certain speed has been attained the two stator windings are connected in parallel, and this group of field windings is connected in series with the two rotors which are still in series. When the car runs on to the continuous-current portion of the line an additional winding, *C,* displaced by 90° against the main winding, *H,* to compensate the armature flux, is switched in. The motor speed is regulated by resistance control for direct current in conjunction with the series-parallel control for alternating current, the same controller being used for both alternating and continuous currents. A regulation by variable ratio transformers was not provided, since there are few stops, so that the losses due to the resistance control are comparatively small. Moreover, regulating transformers would have added to the weight and complication of the car. To change over from single phase to direct current nothing is required but to switch in the compensating winding, *C,* and to connect a direct-current circuit-breaker to the circuit. This is accomplished by means of a small auxiliary switch interlocked with the main controller. The change is made while the car is coasting. No harm will be done if the motors are supplied with single-phase current while connected up for continuous-current working or supplied with continuous current while connected up for single-phase working. The motors consume a somewhat greater current, and in the first case the motor torque is very small, and in the second case it is slightly below the normal. The car is braked electrically by short-circuiting the motors. It is stated that the motors run sparklessly with both continuous current and alternating current. The trials were carried out on the tramway line from Niederschöneweide to Cöpenick, the last 2.2 km. of this 6-km. line being equipped for single-phase working. During the tests the speeds on the continuous-current portion ranged from 15 to 20 km. per hour; on the single-phase part of the line a speed of 25 km. was maintained. Higher speeds (25 km. with continuous current and 35 km. with single-phase current) can be obtained if desired. Fig. 4 is a diagram

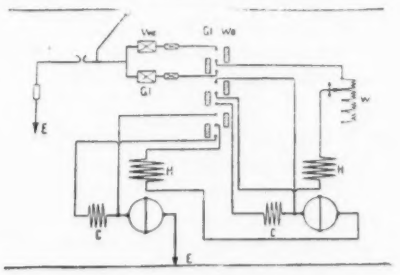


FIG. 4.—DIAGRAM OF CONNECTIONS.

of the connections. *H* is the main winding, *C* the auxiliary winding, *E* the earth, *Gl* refers to direct current, *We* to alternating current.—*Elek. Bahnen,* April 14.

Two-Wheel Truck.—HILDEBRAND.—An illustrated description of a new two-wheel tramway truck. Each truck supports the car at three points. The connection between the car body and the truck at two of these three points is made flexible by means of rocking supports. A car on this principle has been running on the Berlin tramway system since the beginning of last year, and it is stated that the average saving in energy per ton-mile was observed to amount to some 15 per cent over a similar car with fixed axles.—Lond. *Elec.,* April 28.

Signals for Indicating Controller Positions.—A description of a system of Lintern for rear and front signal lamps on trolley cars in connection with the controller contacts. The object is to let the motorman know whether the motorman on the car ahead is applying or shutting off power, or whether he is running with controller on series or multiple position.—*St. R'y Jour.,* May 13.

Paris.—REYVAL.—In continuations of his illustrated serial on the electric equipment of the Metropolitan Railroad of Paris, the substations and the rolling stock are dealt with.—*L'Eclairage Elec.,* May 6, 13.

Railway Congress.—A report of the proceedings of the International Railway Congress in Washington, including the sessions on electric traction.—*St. R'y Jour.,* May 20.

Speed Recorder.—An illustrated description of a speed recorder for use on automobiles. A rotating disc is ruled with concentric circles representing different speeds. The disc also has curved slots radiating from the center and in each slot is a pin, the position of which nearer to or farther away from the center indicates the speed. —Lond. *Elec. Times,* March 30.

Railway Signals.—KOHLFUERST.—An illustrated summary of recent improvements in signal systems for railways.—*Dingler's Polyt. Jour.,* April 8, 15, 29.

Electrolysis of Water Pipes.—SCATTERGOOD.—An account of the means which have been adopted in Los Angeles, Cal., to check electrolysis of cast-iron water pipes due to the stray current of street railways.—*Eng'ing Rec.,* May 20.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Electrical Energy by Central Stations in Switzerland. —An article giving statistical data on the various methods of charging for electrical energy used in Switzerland for lighting and for power purposes. Those plants which have only one uniform flat rate for lighting charge from 33 to 60 cents per candle-power-year, the average being 21.8 cents. Stations which charge three different rates according to the number of hours of burning lamps have the following prices:

500 hours, maximum, 31.2; minimum, 12.7; average, 21.6 cents.
1,000 hours, maximum, 56.0; minimum, 16.0; average, 26.0 cents.
1,500 hours, maximum, 56.0; minimum, 16.0; average, 30.9 cents.

When the energy is charged for on the basis of meter readings for many years a double rate was charged; first, the consumers' rate of 6 to 12 cents per kw-hour, and second, a flat rate per candle-year, amounting to $14 or $18 per kw. The latter, however, gradually disappeared and instead the subscriber guarantees payment of a minimum amount per year, which varies between $6 and $24 for each subscriber per year. Stations which charge only according to the energy consumed charge in general 8 to 16 cents per kw-hour, various discounts being allowed, either according to the equivalent of the connections (in 15 stations) or according to the number of hours of lighting (in 7 stations) or according to the total energy consumed (in 53 out of 115 stations). The percentage of discount allowed on the total yearly consumption differs greatly. Most stations begin to allow a discount on a yearly consumption which represents $40 to $60, with discounts of 1 to 10 per cent. More complicated systems, like Wright's maximum demand system, have not found practical application. In general the charge on the basis of meters is lower than a flat rate, so long as the average number of hours of lighting is 500. For 700 hours the price on the basis of meter charge is 35 per cent higher than the flat rate. For electric current, used for power purposes, 18 out of 88 stations use exclusively a meter rate, 31 a flat rate and 9 both rates. Nearly all stations which charge a flat rate base it on the hp delivered at the motor axle. 14 per cent of these stations have a uniform price per hp-year; the others charge different flat rates, according to the size of motors. In general the yearly rate is,

for 3 hp, maximum, $84; minimum, $27; average, $47.8.
for 15 hp, maximum, $65; minimum, $21; average, $40.4.
for 50 hp, maximum, $65; minimum, $22; average, $36.

The flat rate for permanent all-year energy for power purposes is only 30 per cent and in a few exceptional cases 40 or 50 per cent higher than for 3,000-hour use. The proper rate for current for power purposes is, it is thought, a minimum charge for one year-kw, and a charge for the energy consumed per kw-hour, with dis-

count based on the yearly consumption and the hours of consumption.—*Zeit. f. Elek.* (Vienna), April 16; from *Schweiz. Elek. Zeit.*, 1905, Nos. 1 to 8.

Switchboards.—PECK.—In a continuation of his illustrated serial on modern practice in switchboard design, the author deals with typical switchboards for alternators.—*Elec. Club. Jour.*, May.

Controllers.—EDLER.—An article profusely illustrated with diagrams on the design of controllers, especially for crane motors and traction motors.—*Zeit. f. Elek.* (Vienna), May 7.

WIRES, WIRING AND CONDUITS.

Protection of Cables.—An account of a recent discussion before the London Section of the Electrical Contractors' Association on the best means for protecting cables. Suter referred to the screw-barrel system as an ideal protection, but for many classes of work the cost is prohibitive. He advocated, therefore, what amounts practically to a return to the very earliest method of running cables, namely, to have no protection whatever beyond the actual insulation on the cables. He considered that the cable makers should provide an insulating material for the conductors which would withstand the action of plaster of paris and the various kinds of cements used in buildings, and at the same time protect the copper conductor from corrosive action. Most of the other speakers favored the draw-in-tube system, many of them deeming as unsuitable a system in which the tubes are threaded on to the wires. Human considered that all tube systems should be provided with outlets or siphons to draw off the water which almost necessarily collects in the pipes. Hawtayne also thought draw-in-tube systems to be the best for all buried work, while for exposed work he favors as the least unsightly the system of running twin flexible wires on the walls or ceilings, fixing them up by insulated eyelets. Tate thought that for cheap classes of work, such as residential flats which are wired in course of construction, the mixed system of casing under the floors and piping down the walls is both good and cheap. The report of the discussion is to be continued.—Lond. *Elec. Rev.*, April 28.

Cable Shields.—SCHMIDT.—A long illustrated article on the construction and installation of cable shields. Where cables are placed near water pipes, gas pipes, etc., it is necessary to protect them thoroughly against all mechanical injury, and for this purpose, iron shields must be used. At other places it is sufficient to use clay, cement, concrete, etc. A great many different constructions are described and illustrated.—*Elek. Zeit.*, April 6 and 13.

Steel Cables for Conductors.—In transmission lines in cases where single spans of exceptional length are required, steel wire cables are used instead of copper conductors. With alternating current the use of iron appears at first glance to involve too high a voltage drop, since besides the seven times higher ohmic resist-

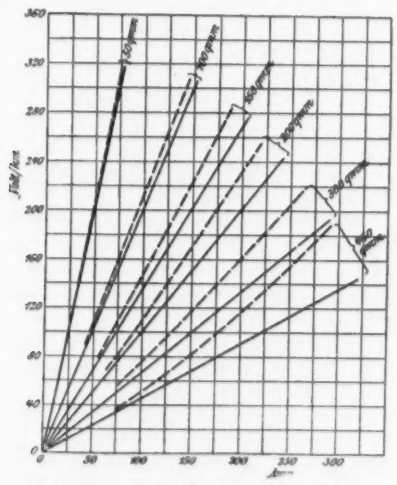


FIG. 5.—CURVES OF VOLTAGE DROP.

ance one might expect a considerable inductive voltage drop. To study this question, the Allgem. Elek. Ges. has recently made tests which show that the resistance of the steel-wire cable or the voltage drop in the same is nearly the same for direct current and alternating current. The tests were made with steel wire cables of different cross-sections with a tensile strength 120 kg per sq. mm, at a temperature of 16 to 20 degrees C. No phase difference between current and voltage was detected; the watt loss is proportional to the voltage drop. Fig. 5 gives the voltage drop in volts per km (ordinates) as function of the current in amperes (abscissæ), the dotted curves referring to alternating current, the drawn-out curves to direct current. Fig. 6 gives the voltage loss in volts

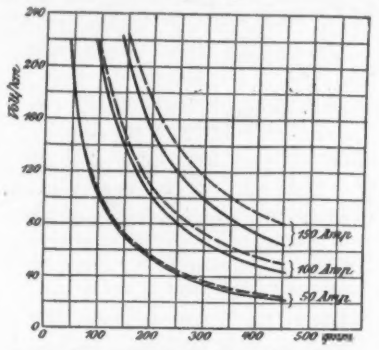


FIG. 6.—CURVES OF VOLTAGE DROP.

per km (ordinates) as function of the cross-section in square mm (abscissæ).—*Elek. Zeit.*, April 13.

Diagrams for Determining the Cross-Section of Conductors.—HOPPE.—An article in which the author develops a very simple diagram for determining the cross-section of conductors required to transmit a given energy over a given distance at a given voltage with a given percentage loss. The same set of curves in the diagram may be used for direct current as well as single-phase and three-phase currents.—*Elek Anz.*, April 30, May 4.

Formulæ for Wire Table.—PENDER.—A note giving formulæ which express in a different form the rules given by Scott concerning the wire table, as recently mentioned in the Digest.—*Elec. Club. Jour.*, May.

Poles.—OTTO.—A mathematical article on the elastic bending of poles in line construction.—*Elek. Zeit.*, April 20.

ELECTROPHYSICS AND MAGNETISM.

Spark Voltage of Air-Gaps.—VOEGE.—It has been found that for air-gaps above a certain length the spark voltage is proportional to the length of the air-gap, and that there is at the electrodes a transition voltage which decreases with decreasing length of air-gap, but is approximately constant for greater lengths of the air-gap, so that the spark voltage is connected with the length of the air d by the law $V = Ad + B$. The author has investigated how far this law is changed by the presence of ionizing agents. He found that the values of A and B in the above formula are not influenced materially by incidental bodies present in the neighborhood, such as lighted flames, incandescent bodies, etc. Concerning the influence of ionizing agents he found the general rule that negative ions near the anode increase the voltage required for a spark, etc., while positive ions at the cathode decrease the same. Any negative ions near the positive electrode represent a resistance for electric discharges and this layer of negative ions at the anode makes up probably an essential proportion of the transition resistance when the electricity passes from the electrode into the gas.—*Elek. Zeit.*, April 20.

Conducting Sphere in a Rotating Magnetic Field.—CORBINO.—An account of an investigation in which the author determined the couple required to make a conducting sphere rotate uniformly in a uniform magnetic field by rotating, not the sphere, but the field itself, using for this purpose Duddell currents of high frequency. He finds that for a given radius the couple is only a function of the ratio between the angular velocity and the resistivity of the conductor, and it retains the same value when the velocity and the resistance change in the same ratio. The couple required by a copper sphere at 500 revolutions per second is about the same as that required by an equal sphere of bismuth at 40,000 revolutions. He found on increasing the frequency that, while at 500 turns the couple on the copper was greatest, at 900 the couple on tin was greater, and at 4,900 turns, bismuth surpassed copper. The theory of this phenomenon has been given by Hertz, and the results go to confirm the theory.—Lond. *Elec.*, May 5; from *Phys. Zeit.*, April 15.

Magnet Coil Winding.—UNDERHILL.—An article illustrated by diagrams giving a comparison of common methods of winding coils for electromagnets.—*Am. Elec.*, May.

ELECTROCHEMISTRY AND BATTERIES.

Edison Battery.—SCHOOP AND LIAGREE.—A summary of the reasons why in the nickel-iron accumulator a solution of 20 per cent of potassium hydroxide is preferably used, while a solution of 29 per cent has the maximum of conductivity. Some instructions are given as to using such solutions, especially for experimental work in the laboratory.—*L'Eclairage Elec.,* April 29.

Organic Chemistry.—MUELLER.—The conclusion of a serial on electrochemical reactions in organic chemistry and their application for industrial purposes. He considers that the application of electrolytic methods in organic chemistry on a large scale is most promising for reduction purposes, especially in the case of the reduction of aromatic nitrocompounds.—*Chem. Zeit.,* April 1.

Sterilization of Water by Ozone.—GUARINI.—An illustrated description of a plant for the sterilization of water by means of ozone, at the municipal water works of the city of Paris at Saint Maur. The de Frise ozonizers are used, and 129 hp of electrical power (including pumping) are stated to be sufficient for the treatment of 1,000 cubic meters of water per hour.—Lond. *Elec. Eng.,* April 14.

Polarization of a Metallic Anode.—MILNER.—An investigation of the polarization produced at a metallic anode by the passage of a certain current, while the cathode is made non-polarizable. The theory of the subject is given on the basis of Nernst's theory of concentration cells, and the results of the measurements of the author are in good agreement with his theory.—*Phil. Mag.,* May.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Oil Testing.—HODGSON.—A very fully illustrated description of the Lahmeyer oil-testing machine. The bearing in which the lubricant is tested is situated between two fly-wheels and the apparatus is driven by an electric motor. For determining the quality of an oil there is employed the so-called "running-down" method, which consists in running fly wheels up to speed, uncoupling, and allowing them to run down to rest, their kinetic energy being dissipated in overcoming the frictional resistance of the lubricant. For ordinary purposes, to compare two coils, it is only necessary to note the time taken with each oil for the fly-wheel to come to rest from a certain speed. For scientific purposes, besides knowing the time of running down, the actual shape of the running-down curve is usually required, which necessitates the speed being observed several times while the wheels are running down. In order to ascertain the effect of heat on the coils under test, the apparatus is provided with suitable heating appliances. Various diagrams and views of the apparatus are given, together with curves of tests, also detailed instructions for using the apparatus, and an outline of the theory of the machine.—Lond. *Elec. Eng.,* April 28.

Measurements of Horizontal Component.—WATSON.—An abstract of a (Brit.) Phys. Soc. paper on the determination of the moment of inertia of the magnets used in the measurement of the horizontal component of the earth's field. The author describes an instrument suitable for comparing the moment of inertia of bars, together with some experiments made with a view to determining the moment of inertia of a standard bar, and gives the results of an investigation concerning the influence of the air upon the period.—Lond. *Elec.,* April 28.

Ballastic Galvanometer.—ADDEY.—A simple proof of the rule that the first swing produced on the needle of a ballastic galvanometer, by suddenly turning on a steady current, is double the deflection at which the needle comes to rest.—Lond. *Elec. Rev.,* April 14.

Testing on Board Ship.—Some illustrated notes on convenient appliances for electric testing on board ship.—Lond. *Elec. Rev.,* April 28.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—BRASCH.—A description of Bull's system of tuned wireless telegraphy, which has already been noticed in the Digest.—*Elek. Neu. Anz.,* March 15 and April 15.

MISCELLANEOUS.

Insulating Material.—HOLTHAUS.—A note describing a new insulating material named galalith, made by the Harburger Gummi-Kamm Company. It is prepared from skim milk, by a process on the whole similar to that employed in the production of ebonite. The result is a material having a structure which also resembles that of ebonite or horn. Water is first removed from the skim milk, the resulting product being hardened and then treated with certain acids, the material thus obtained being plastic. It is next pressed by hydraulic power into definite shapes and is finally treated in a drying stove. Galalith is said to be from about 28 to 30 per cent more elastic than ebonite, and is easily machined. Its density is about 1.4. With regard to insulation resistance and disruptive strength, it is somewhat inferior to ebonite, but it is stated to have a disruptive strength about equal to that of porcelain. This new material is not attacked by fatty substances, oils, benzine or alkalies, and is odorless. It appears that 60 litres (about 13 gallons) of skim milk are required for every kilogramme (2.2 lbs.) of galalith produced.—Lond. *Elec.,* May 12.

Lightning Conductors.—An editorial pointing out that in many cases it is a question whether a lightning conductor does more good than harm. A building "protected" by a lightning conductor is probably more often struck by lightning than it would be without it, and unless the conductor offers a sufficiently clear run direct to earth there is the danger of side flash, when a portion of the discharge will pass through the masonry or metal work of the building to earth. The writer believes that the best way to treat an isolated building, such as, for example, a country house, would be to erect, at a safe distance, a conductor in the form of a tall steel mast or a wood mast fitted with a sufficiently well earthed copper conductor.—Lond. *Elec. Rev.,* April 28.

Labor-Saving Machinery.—An article stating that the wise introduction of labor saving machinery must result in economy, but it is only too evident that its reckless adoption can mean merely the increasing of the capital indebtedness of the business, without showing any corresponding diminution in the revenue charges. In many cases it is simply a matter of transferring the labor charges from the revenue to the capital account. There are given some figures to show that it does not pay to employ mechanical stokers in a power house of some 5,000 hp, since the expense is greater than the saving of labor under English conditions.—Lond. *Elec. Rev.,* April 7. These arguments and especially that with respect to the mechanical stoker are strongly attacked in two letters in Lond. *Elec. Rev.,* April 14.

Manufacturing Plant.—The first part of an illustrated description of the Salford works of the British General Electric Company, a large part of which is devoted to the manufacture of bells, telephones, telegraph instruments and material.—Lond. *Elec.,* May 12.

Underground Cable System.—HULTMANN.—An illustrated but somewhat general and vague description of a new underground cable system for telephony, the main advantage of which is stated to be the fact that the conductors can be spaced farther apart than is usually possible, so as to reduce induction. It is a conduit system with an iron pipe laid in cement with special cross-sectional discs to keep the wires in place.—Lond. *Elec. Rev.,* April 14.

Telephone Cables.—SCHULER.—The conductors which belong to the interior equipment of telephone exchanges are united to form so-called "system cables." The author has carried out comparative investigations on such cables, the results of numerous tests being given in tables and diagrams.—*Elek. Zeit.,* May 4.

Telegraphone.—An illustrated note on improved designs of Paulsen's telegraphone now exhibited in London.—Lond. *Elec. Rev.,* March 31.

Automatic Block Signals.—SCOTT.—An illustrated description of the Taylor electric interlocking signal system.—*Am. Elec.,* May.

BOOK REVIEW.

HIGH-TEMPERATURE MEASUREMENTS. By Le Chatelier and Boudouard. Translated, with additions, by G. K. Burgess. Second Edition. New York: John Wiley & Sons. 341 pages, 79 illustrations. Price, $3.00.

This is a capital textbook on the subject given by the title, and is moreover a marked improvement upon the first edition. It is both wonderful and distressing how little we know concerning the precise measurement of high temperatures. We have no reasonable agreement in the various estimates of the temperatures of the sun for example. Even at temperatures reached experimentally in our laboratories our best information is largely guesswork above 1,600° C. Between 800° and 1,100° C., however, it is pointed out that our meas-

urements can be relied upon to 5° and between 200° C. and 500° C. to half a degree.

The book treats of scales of temperature, the gas-thermometer, calorimeters, electric resistance thermometers, thermo-electric pyrometers, radiation and optical pyrometers, expansion and contraction pyrometers and fusion pyrometers. The theory of all these forms of temperature measures is given with clearness and precision as well as a good many hints on their respective practical use. The book will be found of great value to all students of furnaces and pyrometry.

Kathoden und Röntgenstrahlen. With an Account of the Phenomena of Radioactivity. By Dr. Friedrich Neesen. Vienna: A. Hartleben. 240 pages, 50 illustrations. Price, 4 marks.

This little book forms Vol. LXIII of the "Electrotechnical Library" of the publisher. It gives a clear and interesting summary of the very extensive literature of rays and radioactivity, a subject which is advancing so rapidly that only specialists can keep pace with it. There are eleven chapters in the book, as follows:

I, General Phenomena of Electric Discharge in Gases; II, Cathode Rays; III, Canal Rays; IV, Röntgen Rays; V, Secondary and Tertiary Röntgen Rays; VI, Radiations from Radioactive Bodies; VII, Radioactivity in Air; VIII, The Action of Ultra-Violet Light; IX, The Ionizing Action of Heated Bodies; X, Theoretical Considerations; XI, Practical Manipulation of Radiations. The book will have great interest for those who desire to secure a general acquaintance with the subject of radioactivity.

A New System of Street Illumination.

By Samuel Ferguson.

DURING the past few years great advance has been made in extending the field of electrical application, as well as in the improvement of existing fields. One of the most striking developments in this latter line is the new street lighting system of the General Electric Company, now described for the first time. This system, which combines to a remarkable degree the good features of both alternating and direct-current street lighting installations, cannot fail to be of interest to every engineer familiar with the problems

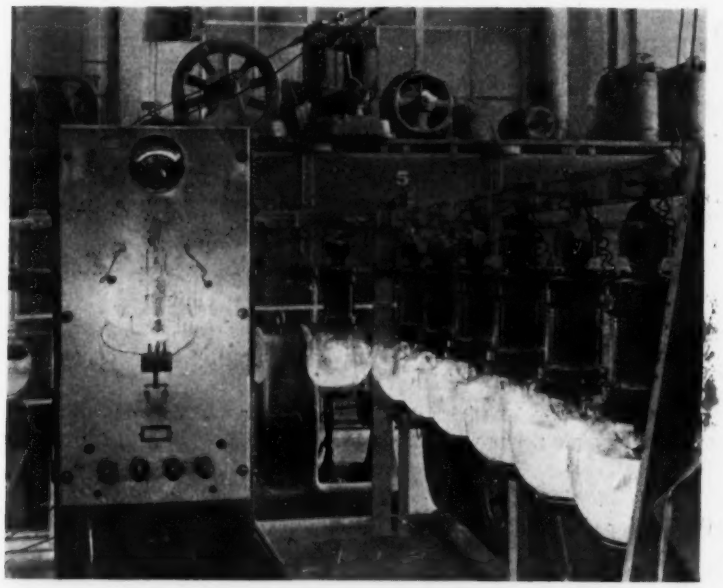


FIG. 1.—RECTIFIER UNDER TEST.

presented by the modern street lighting conditions. Although new, this system has now, after a satisfactory operation of 16 months on a private lighting circuit, passed from the experimental stage and is undergoing the tests of commercial service in a few installations.

Briefly described, the feature of the system is the operation of direct-current arc lamps, of either the carbon or luminous arc type, from an alternating-current supply by means of a constant-current transformer and a mercury arc rectifier, thus obtaining both the excellent light of the diect-current lamps and the perfect regulation of the constant-current transformer, through the medium of a reliable, efficient and simple piece of apparatus.

The remarkable properties of the mercury arc rectifier for low-voltage applications are now well known through the recent introduction of the General Electric battery-charging rectifier panels. Therefore, no theoretical discussion of the rectifier tubes will be attempted here. A few changes in shape from the form of the low-voltage tubes have been found advisable, and a few additional precautions are taken in manufacture, on account of the high voltage to which the tubes are subjected when operating series street lighting circuits. Naturally, difficulties have been met in handling high voltages, but they have not proven insurmountable, and to-day 25,000 volts are handled with the rectifier much more easily than one one-hundredth of this voltage was controlled only a few years ago.

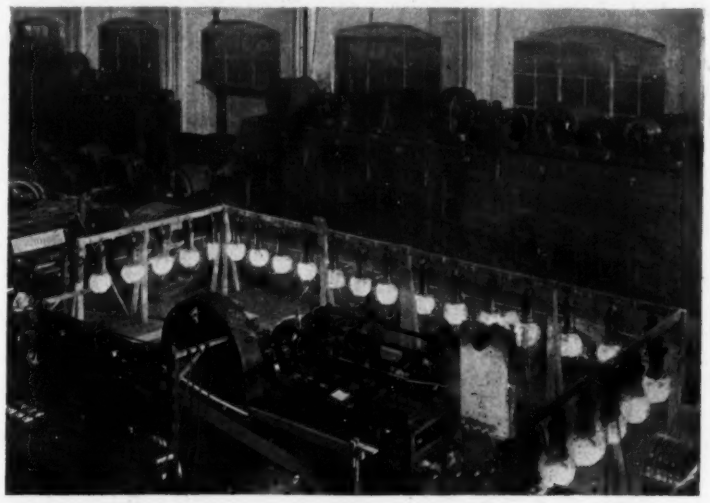


FIG. 2.—TESTING ROOM.

The transformer used to supply the lighting circuit through the rectifier is of the well-known constant-current type, air-cooled except in the largest sizes, where, on account of high voltage oil cooling is preferable. It differs from the standard type only in that it requires a specially wound secondary, having a smaller section of wire and greater number of turns than is usually employed. These special secondaries are usually wound in two coils, thus giving a convenient neutral point to which the negative terminal of the load is connected.

The first commercial installation of luminous arc lamps operated from a rectifier was made by the Schenectady Illuminating Company in March, 1905. The lamps are placed on Dock Street, Lyon Street and Edison Avenue, and have been operated from the rectifier without the slightest trouble or interruption since that time, thus confirming the results of earlier tests, that the system is efficient and reliable.

The accompanying photographs show this rectifier undergoing test, previous to shipment, in the testing room of the General Electric Company. The load of magnetite lamps on which the rectifier is operating is also shown in the photograph. The rectifier is mounted on a pivoted support on the front of the arc light controlling panel. A modification of this arrangement adopted in later sets has been to mount the rectifier on a small marble base and to mount this base above and back from that part of the panel on which the operating switches are located. This arrangement entirely avoids the presence of high-potential terminals on the front of the panel. A small transformer supplies low-voltage, alternating current to a pair of auxiliary starting anodes; consequently, the rectifier may be started before any of the high-tension plugs are thrown in. After starting the rectifier it is necessary only to plug in the circuit and transformer plug switches, starting as though the system were series alternating.

The efficiency of the rectifier system is practically the same as that of the constant-current series alternating arc light system, since at the high voltages used the loss in the rectifier becomes almost negligible. In light efficiency, however, the rectifier luminous arc system shows a marked advantage, on account of the great increase of light given by the luminous arc lamp at approximately three-quarters the energy. Although the same increase of light, due to the use of the magnetite arc lamp, may be obtained from a motor-driven arc light dynamo, there can be no comparison between this method of operation and the rectifier, either in efficiency of the system, amount of apparatus or ease of operation.

The luminous arc lamp derives its superiority from the fact that it is a true arc of luminous vapor and does not depend on incandescent

carbon points for its source of light. Apart from the high luminous efficiency of the iron vapor, a great gain in effective illuminating area is derived from the excellent shape of the light distribution curve, due to the long arc, which is six to eight times the length of the open and two to three times that of the enclosed arc. Thus, instead of a brilliantly illuminated area in the immediate vicinity of the lamp, rapidly changing to comparative obscurity, the area under and around the magnetite lamp is not excessively lighted, and points farther away receive ample and uniform illumination. Consequently the substitution of these lamps for those previously installed at the same time improved the street illumination and greatly reduced the energy consumption. The claim of very long burning electrode, which has frequently been made for this lamp, has been fully substantiated, as the stubs taken from the lamps are very even in length and have uniformly given close to 180 hours' life. The color of the light, being a brilliant white, shows in marked contrast to the violet color of the lamps burning in the immediate neighborhood, and seems to give the nearest approach to daylight of any artificial illuminant so far discovered.

Inasmuch as this installation of the Schenectady Illuminating Company has been in operation only a few months, no data outside the experimental data of the General Electric Company, is obtainable as to the cost of tube renewals. It is evident, however, that even should these tubes not last over 500 hours, which would mean eight tubes per year, the cost of the tube per lamp per year would be low. It is confidently expected, however, that a much longer life than this will be universally obtained, and it is interesting to know that lives of several thousand hours have been obtained in tests made previous to making a commercial installation.

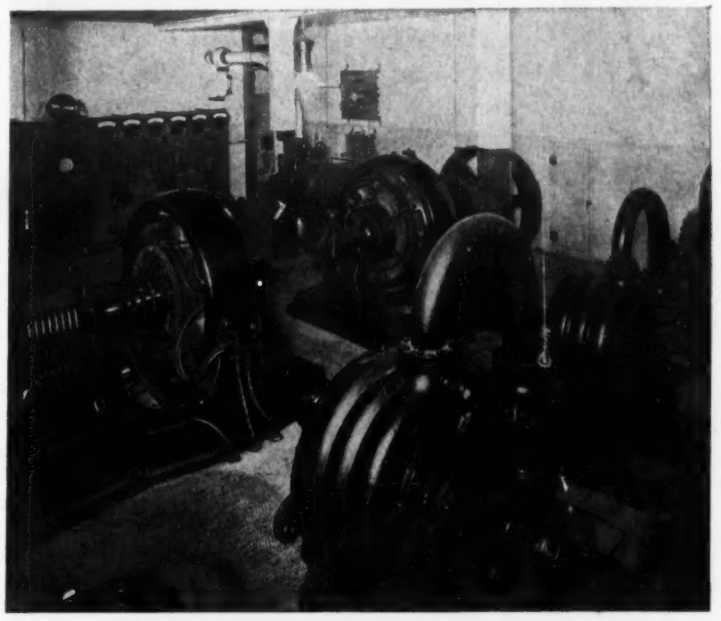
Probably the feature of this system which will appeal most strongly to engineers dealing with low-frequency installations is the adaptability of the rectifier to any frequency. Thus, in 25 or 40-cycle installations, where at present it is necessary either to run motor-driven arc light dynamos to feed the direct-current arc lamp circuits, or frequency-changing sets which furnish power for the constant-current arc light transformers, with the rectifier it is possible to operate arc lamp circuits without any of these intermediate pieces of apparatus, since the pulsations in the rectified circuit are no greater when the rectifier is operated from a 25-cycle transformer than from a higher frequency circuit.

With the proper design of the rectifier system the pulsations of current in the arc light system may be reduced to any desired amount. In practice, however, it has been found that a variation of 25 per cent from the average current will not affect the operation of the lamps or introduce any objectionable conditions.

Motor-Driven Hydraulic Elevator Plant.

THE accompanying illustration of the power plant of the John Taylor Dry Goods Company, Kansas City, Mo., shows three Worthington three-stage, motor-driven turbine pumps operating the hydraulic elevator system in this company's store, which now occupies a city block between Main Street and Baltimore Avenue. This is one of the most complete and up-to-date lighting and power plants of its kind in the country. It contains three direct-connected electric generator units, two of 75 kw and one of 160 kw, each consisting of a tandem-compound, high-speed engine driving a double-voltage, three-wire, direct-current generator mounted upon the extended shaft and sub-base of the engine. These generating units supply power to motors for various services in this large institution, which now has extended its building to cover more than double the area occupied previous to the installation of the new equipment. Power is distributed electrically for operating feed pumps, elevator pumps, a ventilating fan, an ice machine, circulating pumps and other apparatus. Every piece of moving apparatus is actuated by an electric motor, there being no steam-driven machinery in the installation.

Of the three high-pressure turbine elevator pumps, two are of 300 gallons per minute capacity each and each is driven by a 45-hp, 220-volt motor. The third has a capacity of 500 gallons per minute and is driven by a 220-volt motor of 70 hp. These machines were designed to maintain a pressure of 140 pounds in the hydraulic system. The motors are under the control of Cutler-Hammer automatic controlling apparatus mounted on panels and assembled uniformly with the panels of the main switchboard. The three pumps supply the water required for the complete hydraulic system, upon which all the hydraulic elevators of the store are connected. These elevator machines are separated widely over the premises, in some cases nearly a city block apart. During the hours of light load one of the 300-gallon units operating at normal capacity will carry the service. During the hours of heavier service one 500-gallon pump will take care of the load, and during the hours of maximum load the above two machines combined or the two 300-gallon units, if



MOTOR-DRIVEN HYDRAULIC ELEVATOR PLANT.

conditions demand slightly less than maximum capacity and more than the normal capacity of the larger machine.

The nature of the turbine pump is such that a control device is not required except from considerations of economy. The pumps will automatically cease to discharge when the maximum pressure of the system is reached and the current consumption of their motors will fall to that required to merely rotate the mass of water in the impeller chambers. When the pressure is reduced discharge begins and the current increases proportionately to the amount of pumping done. Consequently, the pumps will operate entirely automatically without any special controlling apparatus, which is greatly in their favor, but the addition of the Cutler-Hammer controlling mechanism is considered a step towards greater economy.

This plant was designed in all its details and its construction superintended by the engineering office of W. K. Palmer, Kansas City, Mo.

A Large Single-Phase Locomotive for Heavy Railroad Service.

As already noted in these columns one of the most interesting of the exhibits of railway appliances prepared for the inspection of the delegates to the International Railway Congress, was the Westinghouse-Baldwin single-phase, alternating-current locomotive shown in operation May 16 on the Interworks Railway at East Pittsburg. This locomotive was built by the Westinghouse Electric & Manufacturing Company to convince the railway managers of the world of the possibilities and advantages of the use of single-phase current for the heavy electric traction, and to demonstrate the ability of the company to supply the necessary apparatus. It was shown in operation first running light and then hauling a train of fifty new steel gondola cars weighing approximately 1,200 tons.

From the various details given below and illustrated in the engravings, it will be seen that a number of new features are embodied in the construction of this locomotive. It is the largest locomotive to be operated by single-phase current, the largest alternating-current locomotive in the world, and is equipped with six of the largest single-phase motors ever built. It is the first alternating-current locomotive for use in America and is designed for

the highest trolley voltage ever used in this country. This locomotive is also the largest ever operated by means of overhead trolleys, and it is the first on which forced ventilation is used in the motors.

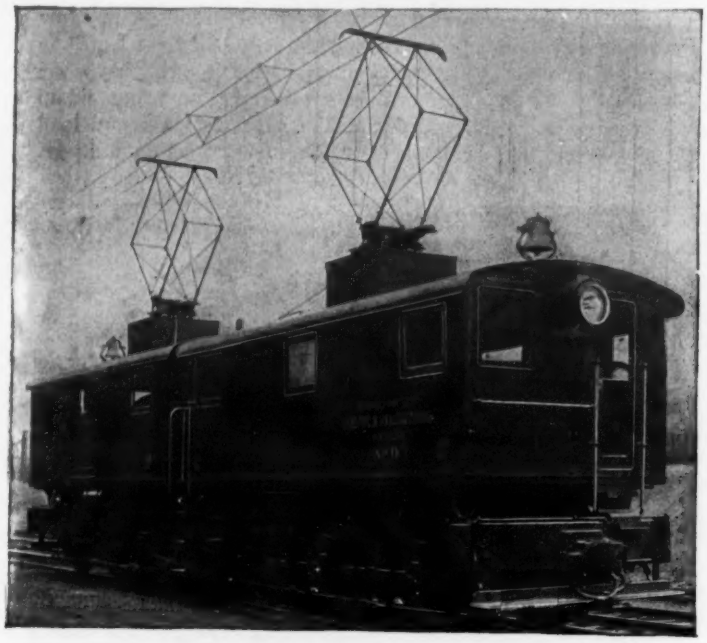


FIG. 1.—GENERAL VIEW OF LOCOMOTIVE.

The weight of the locomotive complete is 135 tons. It is built in halves, each having one six-wheel truck with rigid wheel base. These are coupled together and are intended to operate normally as a single unit, but each half may be operated separately if desired. The locomotive is approximately 45 feet long over all, and 9 ft. 8 in. wide. The total height above the rail with trolleys lowered is 17 ft. The wheels are 60 in. in diameter and are mounted on 8 in. axles, with 6 ft. 4 in. between centers. The side frames of the truck are of cast steel and are spring supported in the usual manner, the weight on the two inside axles of each truck being equalized. The cabs are built of sheet steel with angle-iron supports, and the entire cab as a whole is removable from the truck.

Each axle carries a 225-hp, single-phase series motor of the single-reduction geared type, making a total of six motors for the locomotive. One side of each motor is supported directly on the axle and the other is suspended by spiral springs from the locomotive body. The motors are of the same general construction as the standard Westinghouse alternating-current railway motors of smaller size which have been previously described in these columns. They are so arranged that forced ventilation may be used and increased output thus secured.

The locomotive is designed for a current of 25 cycles and a trolley voltage of 6,600, and one of the most striking points of the exhibition to those who have been accustomed to the enormous currents required in heavy direct-current traction work, was the sight of so large a locomotive accelerating a 1,200-ton train over a third of a mile in length and receiving its entire power supply from a single No. 000 trolley wire. The 6,600-volt current is collected from the trolley wire by a pneumatically-operated pantagraph trolley on each

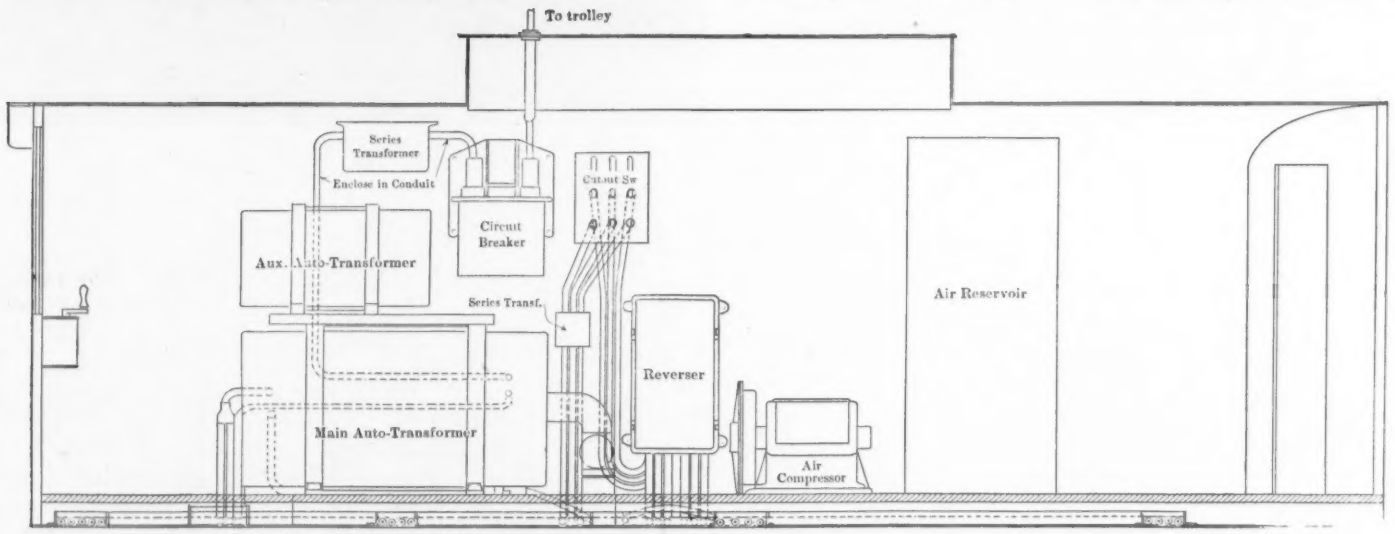


FIG. 2.—LONGITUDINAL SECTION SHOWING WIRING.

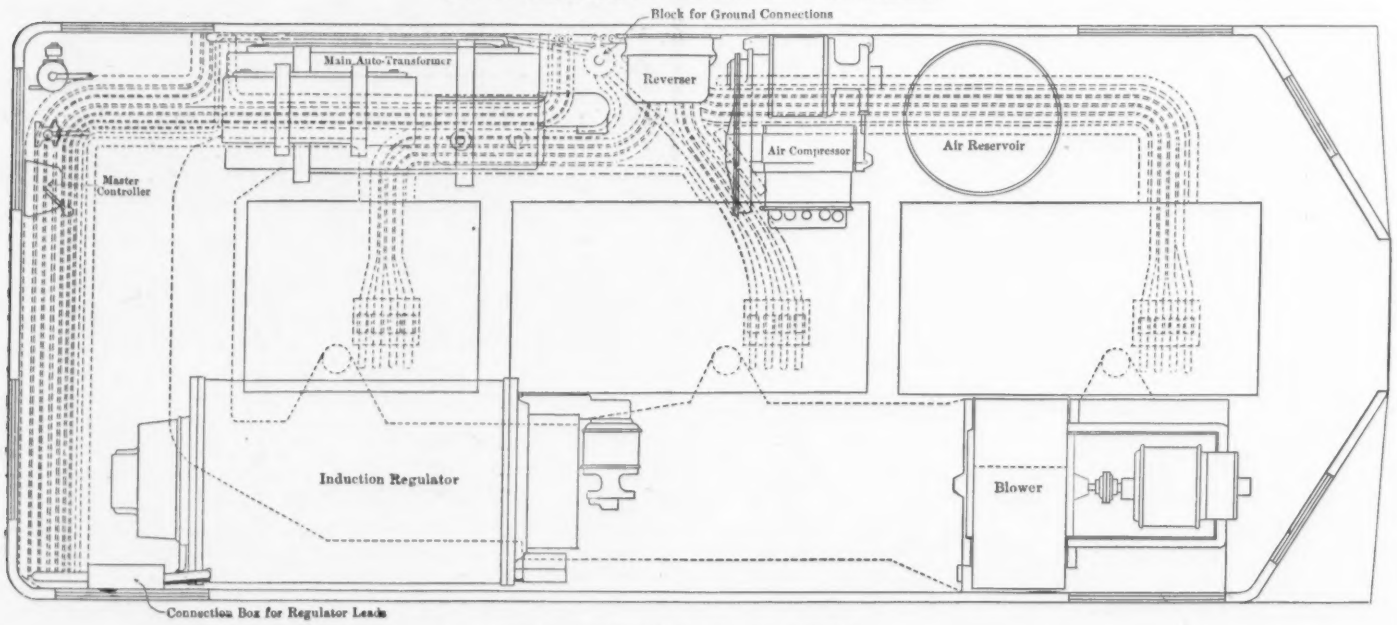


FIG. 3.—GENERAL PLAN AND WIRING.

half of the locomotive, and is carried through a suitable oil switch and circuit-breaker to an auto-transformer in each cab. These transformers reduce the voltage to 325 for use at the motors. The trolleys may be raised or lowered from the cab by a suitable air valve.

The three motors on each half of the locomotive are connected permanently in parallel and are controlled by means of an induction regulator, which, under the direction of the operator, varies the voltage at the motors from about 140 to 325. The induction regulators are driven by small series motors of the same general type as the main motors. Both regulators are controlled by the multiple-unit system from a master switch at either end. They may be stopped at any desired point in their travel, and thus the motor may be run at any speed with the same facility and economy as a steam locomotive.

Forced ventilation is used with the auto-transformers and induction regulators as well as with the motors, the necessary air being supplied by suitable motor-driven blowers. Motor-driven air compressors are also used.

The locomotive is designed for slow-speed freight service, this type having been chosen because the design of series alternating-current motors for very slow speed service presents many more problems and is much more difficult than the design of equal capacities for the ordinary conditions. This problem having been solved, the production of similar locomotives for passenger service becomes a relatively simple matter. With the motors working at normal full load output, the locomotive will develop a draw-bar pull of 50,000 pounds at a speed of approximately 10 miles per hour. On several occasions, however, when hauling the 50-car train referred to above, steady draw-bar pulls of from 60,000 to 65,000 pounds have been recorded on the dynamometer car, and momentary efforts as high as 100,000 pounds have been obtained with no sign of slipping of the wheels. With lighter loads, the locomotive may be run at higher speeds up to a maximum of about 30 miles per hour.

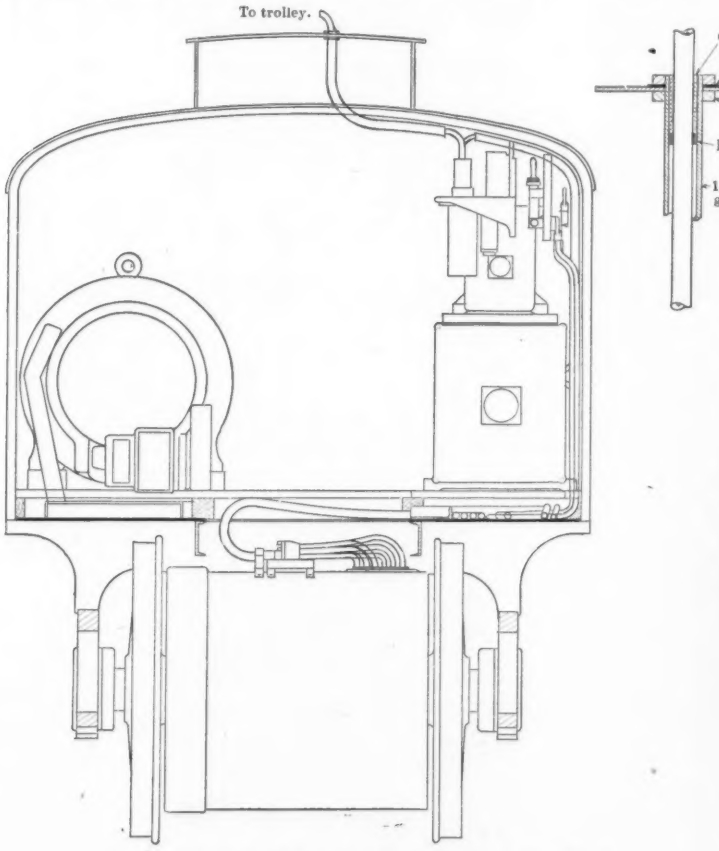


FIG. 4.—CROSS-SECTIONAL VIEW OF LOCOMOTIVE.

Power from the Wisconsin River.

The Rhinelander Power Company, of Rhinelander, Wis., composed largely, if not entirely of local parties, has completed arrangements to develop the water power of the Wisconsin River at a point about six miles below the city of Rhinelander. A dam will be built giving a head of about 24 ft., and sufficient water is obtainable to develop an average of about 600 hp. In the rainy season more than 2,000 hp, at a conservative estimate, is obtainable.

The Allis-Chalmers Company will furnish the entire electrical equipment, which includes three 400-kw, 1,100-volt, three-phase, 60-cycle generators, with three 70½-kw, 120-volt separately driven exciters, six 150-kw, 10,000-volt transformers and complete switchboards at both the generating station and the sub-station at Rhinelander.

The current will be carried at 11,000 volts over a single three-phase circuit to the sub-station at Rhinelander, a distance of about six and a half miles, and from this sub-station will be distributed at 1,000 volts for illuminating purposes, both commercial and street lighting, and also at 440 volts to the mill of the Rhinelander Paper Company and other industries in the neighborhood of the sub-station.

This plant is one of the first long-distance transmission plants on the upper Wisconsin River. It is expected that many more enterprises of a similar character will be undertaken in that region within the next two years.

Experimental Laboratory for Telephone Work.

The story of the struggle for the control of the Kellogg Switchboard & Supply Company, of Chicago, is so familiar to our readers there is no need to repeat it, but probably some curiosity has been entertained as to what might be going on aside from the litigation, and as to what Mr. Kellogg might be doing. It is, therefore, interesting to note that during the last year some of the foremost telephone engineers, inventors and patent experts, whom Mr. Kellogg had had in his employ in the Kellogg Company, and a few other telephone engineers and inventors have been quietly but industriously at work in offices in the Association Building in Chicago. The character and scope of their work has been unknown, but it was generally understood that they also were working for or in Mr. Kellogg's interest in furtherance of the same object. Mr. Kellogg has heretofore declined to make any general statement as to his plans and objects, and those who have thus been in his employ have declined to give information as to the character of their work, and the whole undertaking has been the subject of considerable surmise. Mr. Kellogg has now consented to give out some statement as to his plans and purposes, which are found to consist in being ready for a new departure in the telephone field.

TELEPHONE EXPERIMENTAL LABORATORY.

While Mr. Kellogg considers that he has very strong grounds for expecting a favorable conclusion of his suit, he realizes that the law is not a positive science and that the outcome of the litigation may perhaps be contrary to his expectations. Should this result, he expects by that time to have a full line of the highest form of telephone apparatus devised and ready to place on the market, of kinds which are free from the patent claims of others, so that he will still be in a position to serve the independent telephone field in the future, substantially as in the past. At the present time, however, he does not plan to enter the manufacturing field in advance of the final decision in the litigation, or at least until there are further developments in the suit. This conclusion, however, is not con-

sidered by him as final. The case comes up on appeal in Chicago in June and may be settled during the summer.

We illustrate herewith the Kellogg laboratory and its staff. The new apparatus upon which it has been engaged comprises multiple switchboards, semi-automatic switchboard systems, full automatics and long-distance work.

Changeable Signs.

The development of the electric sign industry is in itself a sign of the times, and no active, progressive central station company loses the opportunity to cultivate this new class of business. As a means of advertising, the electric sign has already proved itself valuable, and there is a ready welcome for any meritorious development or improvement in this field.

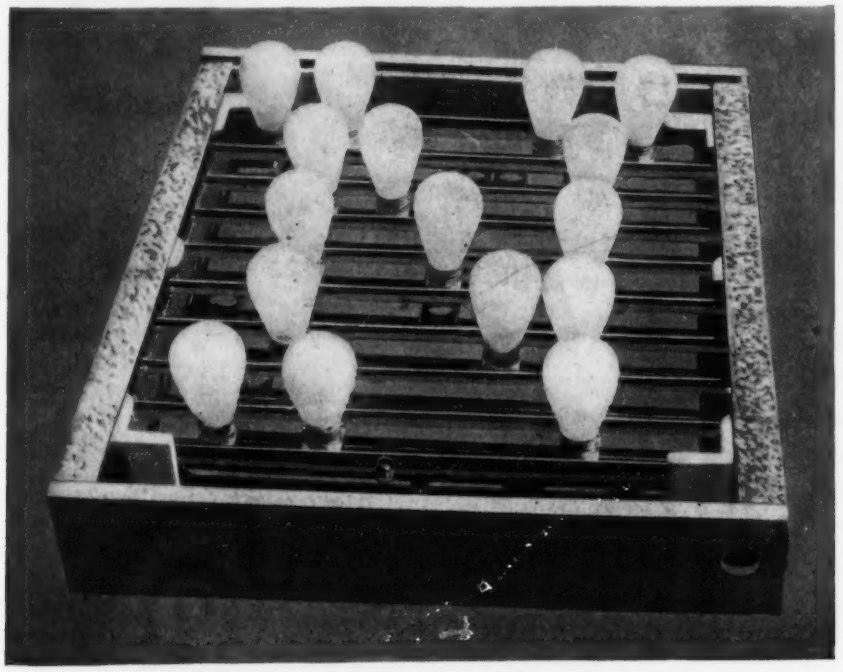


FIG. 1.—CHANGEABLE SIGN.

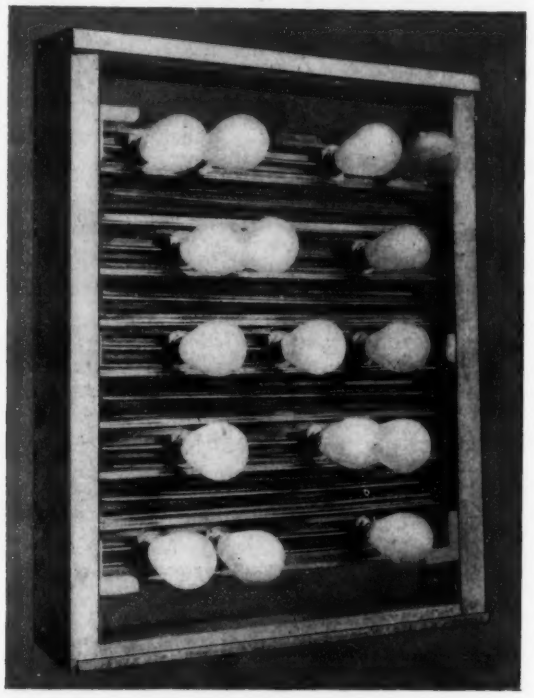


FIG. 2.—CHANGEABLE SIGN.

The Mobile Electric Company, of 30 Lawrence Street, Newark, N. J., has been introducing its signs recently and has experienced a brisk demand on account of the ingenuity and availability of its product herewith illustrated. The system is a striking and attractive one. The unit of the Mobile sign is a galvanized-iron box. This contains two frames or grids of parallel brass bars insulated and held apart by porcelain corner and side pieces. The upper grid is so constructed as to form horizontal tracks for a specially devised lamp holder or socket suitable to receive Edison base lamps. The lower grid forms a series of ridges directly beneath the center of the tracks in the upper grid. In this manner a lamp screwed down through the open bottom of the socket is enabled to make contact with the ridge in the lower grid and thus completes the circuit. The sockets or holders are made in one piece of heavy brass drawn and threaded to hold a lamp securely and bent on the sides to form slots which can engage the tracks in the upper grid. As will be readily understood, these holders are easily sprung into position in any desired number at any point in the grid. When in position they slide horizontally on the tracks, and thus can be grouped without trouble to form any letter or device. Double-face units are made of three grids, the two outside grids forming tracks for the lamp sockets, while the center grid has ridges on both sides, against which rest the bases of the lamps. Thus the sign can be read from two opposite directions and if necessary a different letter can be formed on each side of the unit.

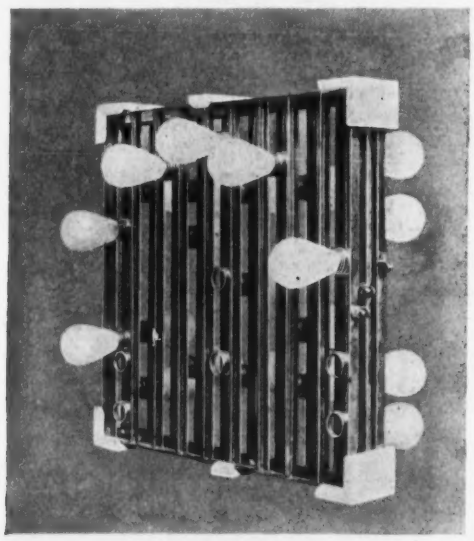


FIG. 3.—CHANGEABLE SIGN.

Each Mobile unit or base has fitted over it a steel face plate. These are perforated for lamps and heavily enameled with a white letter on a background of blue or black. These face plates are held by grooves at the top and bottom of the unit so that they can be easily slipped in and out and adjusted, and when in place they fit securely, protecting the interior of the case from the weather.

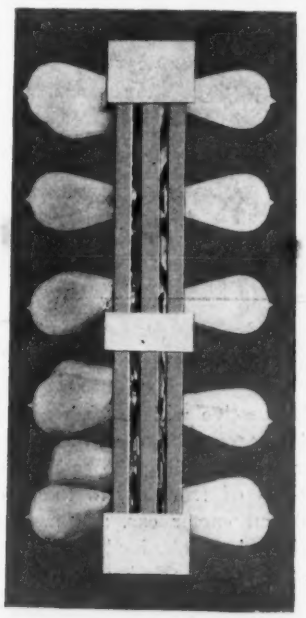


FIG. 4.—CHANGEABLE SIGN.

It will be seen that there is thus constituted a wireless electric sign. The only wires used are the connections from the bottom of each grid, and these are carried throughout the entire length of

the sign by means of ingeniously arranged conduits which are part of the box construction. By the use of these conduits no iron pipe is needed to conceal the connections and absolutely no wiring is exposed to view. Central station companies, if they desire, can construct these signs in their own shops, building up the Mobile changeable bases and face plates.

The design and methods of construction of these signs are shown in the illustrations herewith. The signs when complete are made up in a series of the desired number of units or letters held in a frame of T or angle iron so as to hang vertically, or horizontally, against the building, or if desired at right angles to it across the sidewalk. The vertical signs include in their construction an iron ladder running the full length, while the horizontal signs are so built as to swing inward toward the building, enabling an easy change of the wording or a renewal of the lamps. The two sizes adopted as standard give letters either 15 or 18 in. high. The smaller size has four lamps in the vertical and the face plate contains an average of nine lamps per letter. The larger size has five lamps in the vertical, and the standard block letter face plates contain an average of 13 lamps per letter, while the standard Egyptian letter face plates average eleven lamps. The company prefers 4-cp, frosted lamps for its work.

Fig. 1 herewith gives an oblique view of the Mobile base without the face plate. Fig. 2 shows clearly the tracks for the sockets and the method of making connection. Fig. 3 is an oblique view of Mobile grid work, showing a double-face unit, while Fig. 4 is an interesting end view of a double grid showing the lamps making contact on the inner grid. The various details of this sign work have been carefully worked out by the Mobile Company, whose signs are now finding a ready adoption.

High-Tension Switches.

In the construction of high-tension, alternating-current systems a definite demand has arisen for an oil switch and circuit-breaker which can be installed directly on the back of the switchboard and operated by hand from the front of the board.

In the design of the apparatus shown in the accompanying illustrations, particular attention has been given to the insulation of the live parts of the switch from the operating mechanism, in order that the switch might be installed on the back of the switchboard and used for very high voltages with entire safety to the operator. This has been accomplished by using a new material in oil switch construction, viz.: moulded fibre treated by a process which gives to it insulating qualities substantially equal to porcelain. Each pole of the switch is enclosed in a separate tank or cell made of this fibre.

FIG. 1.—OIL SWITCH UNIT.

The cover of the tank with its two insulators is also made of treated fibre, and the live parts which are enclosed in the tank are thus completely insulated from the metal supporting frame and operating mechanism. In switches intended for voltages above 6,600, the oil tank is moulded in such a way that, together with the wooden switch rod, a complete barrier is interposed between the two arcing points of the switch element.

Two, three and four-pole combinations are made up of the single-pole element shown in Fig. 1. These are clamped side by side to sections of seamless steel tubing which is fastened rigidly to the switchboard plate. This construction permits of liberal spacing between the poles without increasing the weight of the switch.

Of the automatic switch or circuit-breaker two types are made. In the one type, which is shown in Fig. 2, the overload coils are mounted on spools of treated wood and are operated directly from the high-potential circuit. This construction dispenses with the use of current transformers, and effects a corresponding reduction in the price of the circuit-breaker. The insulation of these coils has been worked out with great care and is entirely adequate for the

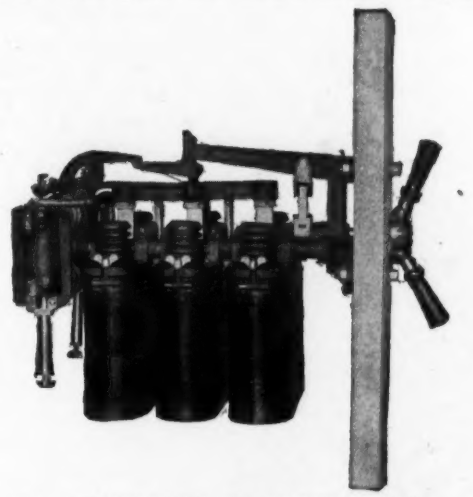


FIG. 2.—AUTOMATIC OIL CIRCUIT-BREAKER.

voltages for which these circuit-breakers are recommended. In the second type of circuit-breaker the overload coils are mounted substantially as shown in Fig. 2, but they are energized from the secondaries of series transformers. This circuit-breaker is made for potentials up to 22,000 volts. Each of these circuit-breakers possesses the feature that it cannot be closed while an overload exists on any phase of the line.

While these switches and circuit-breakers were designed mainly to be placed on the switchboard, they can also be installed apart from

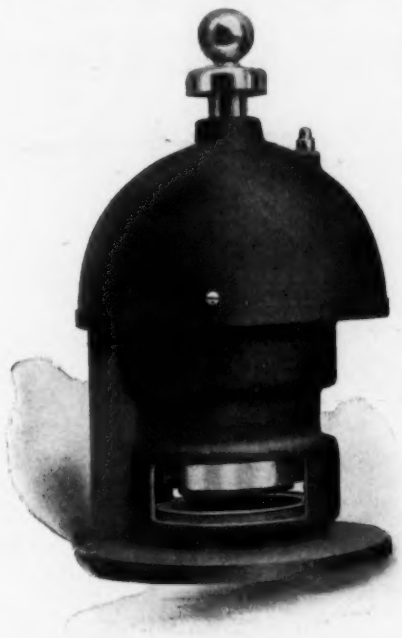
FIG. 3.—15,000-VOLT NON-AUTOMATIC OIL SWITCH.

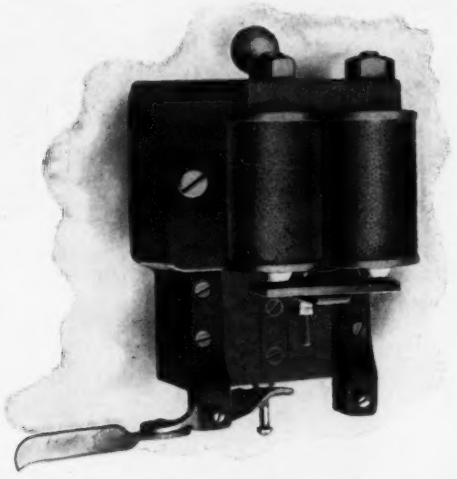
the panel and operated manually by a simple system of cranks and rods, or they can be operated electrically by means of solenoid control. In this case the operating current is derived from the exciters, a storage battery or any convenient source of direct-current supply.

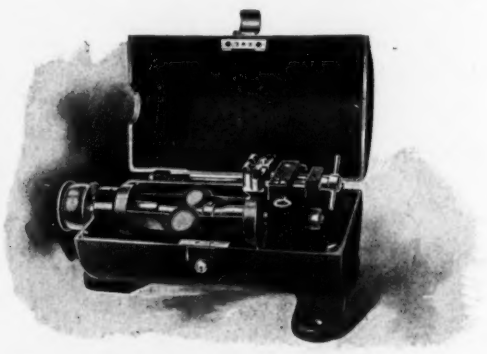
The apparatus described above is representative of a complete line of high-tension oil switches and circuit-breakers which the Hartman Circuit-breaker Company, Mansfield, Ohio, has been developing for the past four years.

Engine Stop and Speed Limit System.

The desirability of stopping an engine from a distance in order to prevent accidents to life or property has been recognized from the earliest days of steam engineering. In some cases provision for this purpose was made through the use of an alarm bell placed in the engine room, to be operated from one or more distant stations. A rather crude system has also occasionally been employed, whereby a heavy weight controlling the throttle could be released from one or two stations by mechanical means. Some years ago this subject was taken up by the Consolidated Engine Stop Company, which devised a very complete system in which the electric current figures as the operating agent. This system has been added to from time to time until at present it includes mechanisms adapted to all the various types of steam engines and also to electric generators and motors and steam turbines.







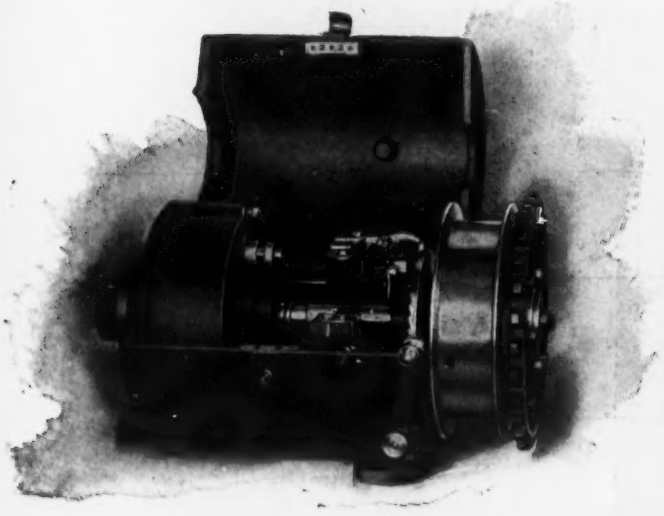
FIGS. 1, 2 AND 3.—ENGINE STOP AND SPEED LIMIT SYSTEM.

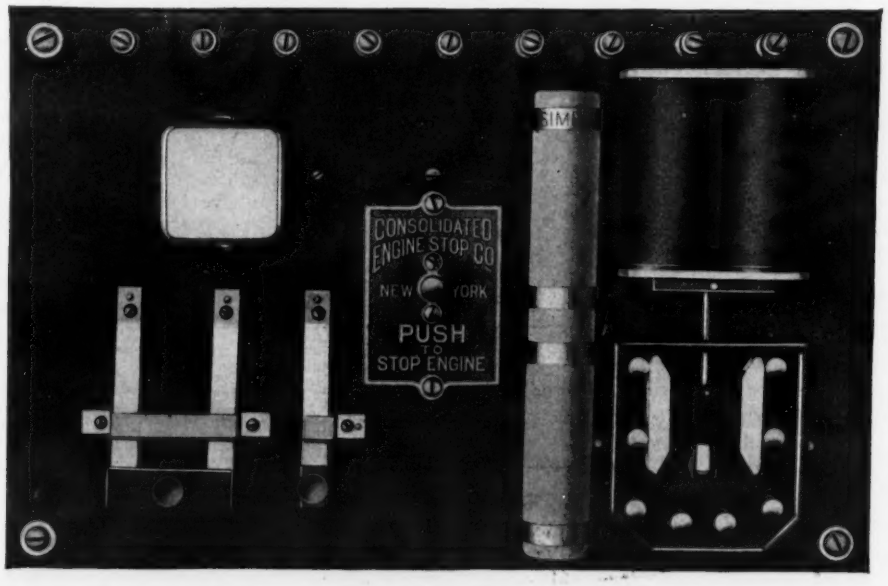
As applied to an ordinary steam engine or turbine, the stop mechanism acts on the throttle valve. A cable attached to a weight passes around a drum, and when a magnet forming part of the apparatus is energized, a pawl is tripped, which allows the weight to descend; on the shaft with the drum is a sprocket wheel, the chain of which is connected to the throttle mechanism, and as the weight descends the throttle by this means is closed. This type of Monarch engine stop is shown in Fig. 1. Another type is made for application to engines having a Corliss valve gear.

Another part of the system consists of a speed limit device, by means of which when the speed of an engine or other source of motive power exceeds a predetermined limit, an electrical contact is made which operates an engine stop like the one above described. To provide for the case of condensing engines, where it is frequently desirable to break automatically the vacuum in case the engine should be shut down by the speed limit, an automatic vacuum-breaker device is provided, which is in circuit with the engine stop and acts simultaneously with it.

To provide for the case of electric light and power plants or where generators are operated in multiple and driven by separate engines, and where it is desirable to open the generator circuit simultaneously with the shutting down of any particular engine, a circuit-breaker trip has been devised. This consists of a weight which is attached to the circuit-breaker; when the circuit is closed to shut down the engine, the magnet on the trip at the same time draws down an armature releasing the weight, thereby tripping the circuit-breaker. This apparatus is also applied to stop electric motors in factory or other service.

The details of the electrical circuits have been worked out in a very complete manner. A small slate or marble testboard is used having upon it a switch for tripping the stop, a buzzer or a lamp, and two small key switches, which are used for testing the circuits. The buzzer is of high resistance and if the batteries become weak an intermittent response of the buzzer will indicate this and yet current for at least 24 hours is still available to use the stop, thus allowing sufficient time for recharging the batteries. A failure of the buzzer to respond to the test switch indicates a break in the wiring, but it is possible to shut down the engine either





FIGS. 4 AND 5.—ENGINE STOP AND SPEED LIMIT SYSTEM.

automatically by the speed limit or from any of the other push switches pending repairs to the wires. This is accomplished by throwing the wires from multiple into series for a test, so that though the indication of a break in the circuit is instantly detected, the engine stop system is still in commission. These testing provisions are, it will be recognized, valuable additions to the system, as they insure absolute reliability, since the safety device cannot unknown be crippled by weak batteries or broken wires, but is always ready for emergencies. The most serious objection which can be raised against any safety device, as is appreciated by all, resides in

any tendency for the device to become inoperative without that fact becoming known because of lack of use.

There is also another testboard in use substantially the same as the one just described, but with the addition of a solenoid switch. This is designed for the employment of current from lighting or power circuits to operate the engine stop, with a battery in reserve, and is adapted for 110, 220 or 550-volt circuits. The voltage is cut down by means of resistance coils on the testboard. The current going through the solenoid holds the armature against the magnets; if the generator furnishing current is shut down or a fuse blows, the armature falls by gravity to the battery terminal, and the engine stop system is thus switched on the battery circuit until the service current is again available. This system adds an additional safeguard from the fact that there are two sources from which to operate the engine stop. It is particularly desirable in factories where the generator current is not on during the day, since it lengthens the life of the batteries on account of the fact that they need be used throughout only a portion of the time.

A 10,000-Amp. Motor-Starter.

A direct-current motor equipment, which is of particular interest on account of the size and design of the starter, is soon to be installed in the Edgar Thomson Steel Works, of the Carnegie Steel Company, at Braddock, Pa. There will be used two 250-volt, 1,500-hp, automatic-release starters, which are designed to withstand from 6,000 to 10,000 amp. The starter proper will be built in the form of a switchboard of white Italian marble, approximately 7 ft. 8 in. high and 11 ft. long. The parts will be of the well-known type used by the Cutler-Hammer Manufacturing Company, where the several sections of the starting resistance are controlled by a number of independent levers. For the apparatus in question the levers which will carry the motor current continuously are to have a capacity of 10,000 amp., and are guaranteed to carry this amount with a temperature rise not exceeding 40° C. The intermediate starting levers, which as occasion demands may also be used temporarily for regulating duty, will have 6,000 amp. capacity on the same basis.

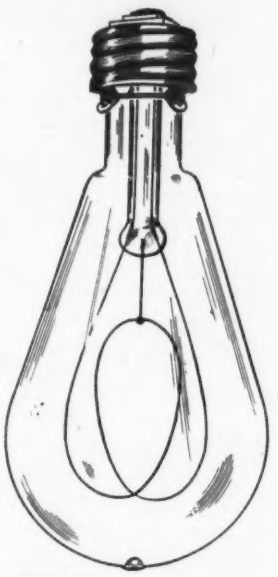
The switchboard will consist of five panels, each panel containing two levers. The connection between the different panels will be made at the rear of the switchboard by bus-bars in the usual manner. At the front of the switchboard such arrangements will be made that with very little trouble an entire panel may be removed from the board without disturbing the other panels, or the parts mounted on them. It will even be possible to operate the starter with one of the intermediate panels removed. The levers on the several panels are mechanically interlocked in the manner adopted for the multiple switch type of starters, so that the several levers composing the starter cannot be operated except in a predetermined order. As giving some idea of the large size of the starter levers, the overall length of each is a trifle over 3 ft., but by means of a toggle joint action these heavy switches may be closed with a remarkably small amount of force.

The resistance will consist of standard steel rails, mounted in a steel rack, approximately 20 ft. high, 14 ft. wide and 27 ft. long. There will be about 100 25-pound rails and 200 40-pound rails used. This enormous capacity of resistance material is provided so that the resistance may be used to control the speed of the motor for short periods of time, even under comparatively heavy loads, without permanent injury. The main connections to the starter will consist of six cables, having an area of 1,000,000 circular mils, while the intermediate resistance leads will consist of four cables, each having an area of 1,000,000 circular mils.

The motors which these starters will be used to control are of Westinghouse make, and will be very heavily compounded. The armature shaft will carry a fly-wheel 20 ft. in diameter, weighing approximately 125,000 pounds, and will be directly connected to the standard blooming mill rolls. The motors will be designed to withstand very heavy overloads for short periods of time, and mechanically constructed so as to withstand the enormous strains encountered in this service. The normal speed of the motor will be 100 r.p.m., and allowances will be made so that this speed may be increased 25 per cent by varying the current in the shunt field circuit of the motor.

The Lamp With a Dimple.

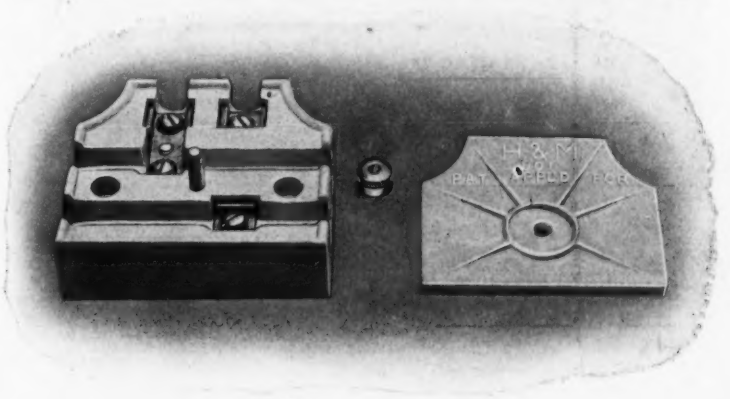
The electric light manager and the general public are thoroughly familiar with the incandescent lamp with a tip, and also with the tipless lamp. A further variety of variation is now brought to their notice in the lamp with a dimple, which is herewith illustrated, and which is being placed upon the market by the Missouri American Electric Company, of 3327 Locust Street, St. Louis, Mo. The dimple lamp, which was patented recently by Mr. G. P. McDonnell, of that company, has some interesting features which may be briefly noted. In the old style of tip formed by sealing off the lamp after exhaustion, it frequently happens that there is a very thin part of the glass which is liable to leak or break, thereby destroying the lamp so far as its utility is concerned by the release or reduction of the vacuum. The method of construction also avoids a large part of the breakage which occurs in transportation and in handling the ordinary lamp. Objection is also sometimes raised to the old style of lamp tip because of its sharpness and the danger thereby incurred from personal contact with it. Moreover, in forming the new style of tip or dimple, it will be noticed that a bead forms in the center, which naturally serves to strengthen the glass at this spot. It is believed that by this method of construction the general desire for a tipless lamp may be met without incurring an advance in cost owing to the greater difficulty in its production. We understand that this new lamp is to be called by the manufacturer and known to the trade as the "Inner-Tip."



IMPROVED LAMP BULB.

Moulding Branch Blocks.

One of the delicate and important operations in interior wiring is that of making branches, and with the hope of simplifying such work and making it thoroughly permanent in character, the Elm City Engineering Company, of 61 Orange Street, New Haven, Conn., has brought out the "H. & M." moulding branch blocks, which are manufactured in six different styles, each block being packaged in a neat paper box for shipment. The device is so simple as not to need elaborate explanation, the cut herewith sufficing to illustrate its applicability. There is no cutting of the moulding to accommodate joints, no soldering, no loose joint and no exposure of wire. The blocks are placed where branches are desired, and the main line of moulding can be completed and the branches finished off afterward, instead of splicing the branches while the main line is in progress of construction. It will be appreciated, therefore, that the design of the block is such as greatly to facilitate the installation of moulding work.



MOULDING BRANCH BLOCK.

"Gyroscope" Motor Truck.

The motor truck shown in the accompanying illustrations possesses the novel feature that the driving electric motor forms part of the wheel. Each wheel contains a 2-hp machine, designed for a speed of 1,400 r.p.m. The gear reduction is 25 to 1, which, without the aid of countershafts, gives to the car a speed of six miles per hour. The motor is mounted with its armature at right angles to the axle of the wheel, and is provided with two pinions, one

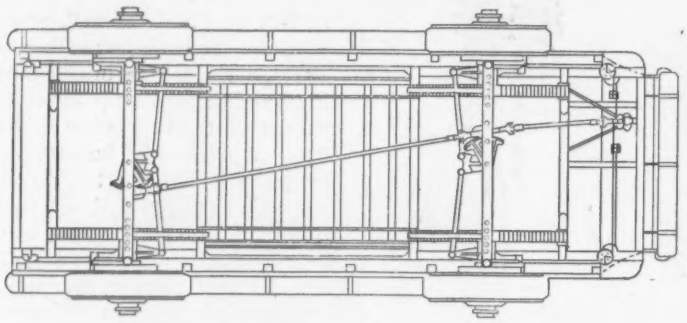


FIG. 1.—STEERING GEAR OF ELECTRIC TRUCK.

on either end of the armature shaft. These pinions drive bevel cog racks in the external circumference of the wheel's frame. One pinion pulls up on one side of the wheel, and the other pulls down on the opposite side, the couple action of the two equal forces relieving the thrust from the main bearings of the wheel. The frictional losses are, therefore, reduced to a minimum. It is stated that after fourteen months of continuous operation, the motors of the truck, shown in the illustration, are in perfect condition, and the pinions show no appreciable wear. The practical elimination of friction in the driving gear results in a large reduction of the demands on the storage battery.

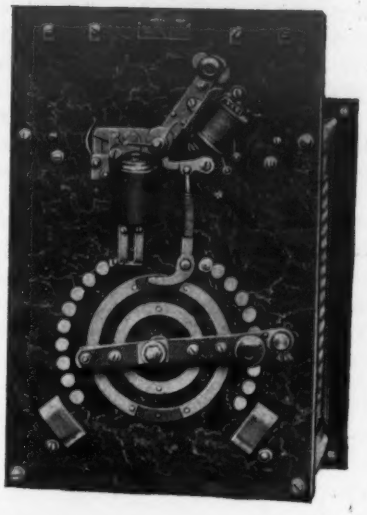
The steering gear is noteworthy in that the wheels on either axle can be steered independently of the others. The gear is illustrated in Fig. 1. In turning corners the rear wheels follow exactly in the tracks of the forward wheels. In the oblique steer the four wheels are all turned in the same direction. The rear wheels may be caused to run parallel to the body of the truck, and the steering be effected from the front wheels only. These

FIG. 2.—MOTOR TRUCK IN MAIL SERVICE.

changes are accomplished by the driver without leaving his seat and without stopping the truck. The flexibility of the steering mechanism is especially advantageous for heavy freight trucks. The four-wheel drive effects a large saving in wear on the tires, and the four-wheel steer adds tremendously to the convenience of the truck for heavy work.

The vehicle illustrated weighs 7,900 pounds complete, with an Exide battery of 42 cells. The carrying capacity is 5 tons, with a speed of 6 miles per hour. The controller is of the cylinder type, and provides for five speeds forward and back. Each wheel is equipped with its own band brake. The truck was built by the Holson Motor Patent Co., Grand Rapids, Mich.

Reversing Armature Controller.



REVERSING ARMATURE CONTROLLER.

The engraving shows a newly designed Ward Leonard reversing armature controller made by the Ward Leonard Electric Company, of Bronxville, N. Y. The motor and rheostat are protected against overload at all times, even the time during which the operator has hold of the controlling lever. The circuit through the rheostat and motor cannot be closed unless the controlling lever is in a protective, i. e., open circuit, position. The overload device is a circuit-breaker. The circuit-breaker is a spring-actuated breaker having the release mechanism operated by a hammer blow delivered by a core moved against the action of gravity, and has its own independent contacts for breaking the circuit. The no-voltage release magnet is responsive solely to the line voltage and is entirely independent of the current in the armature or fields. The controlling lever can be moved freely in either direction to obtain the speed changes desired.

The resistance is built up of enameled resistance units, in which the resistance wire is entirely enclosed, while the resistance units are well ventilated and readily renewable. The resistance will stand for one minute, without injury or alteration, a current of 50 per cent in excess of the full load at which it is rated for continuous duty. The resistance is so protected that it will not become displaced or fall out in case it should become melted or overheated at any point. The insulating material will not smoke or smell when tested as above.

Electric Appliance Company's Expansion.

The Electric Appliance Company, of Chicago, has for the fifth time in fifteen years sought larger quarters, and is now comfortably settled in its new building at Jackson Boulevard and Desplaines Street, Chicago. The building fronts 100 ft. on Jackson Boulevard and 100 ft. on Desplaines Street and is six stories in height. It is very conveniently arranged for carrying on the supply business. The city sales, receiving and shipping departments are on the main floor. The second floor is given up to offices. The remaining four floors and the basement are occupied with stock, with the exception of a part of one floor assigned to telephone manufacturing. It is interesting to follow the growth of this supply business since its beginning in a small way in 1891, when it was organized by Willard W. Low, its president, and Thomas I. Stacey, secretary and treasurer. The first quarters on East Madison Street took up one floor of a small store building. Later the basement and two upper floors were added. Six years ago a radical move was made. A large five-story building on the west side at Van Buren and Jefferson Streets was secured, but even this was large enough for only two years, and a separate warehouse on Canal Street was established for heavy and bulky material. Finally the business grew so that the company was in danger of losing its reputation for prompt shipment unless decidedly larger quarters were obtained. Last summer architects were set to work to design a model supply house, and the building was ready for occupancy by May of this year. The company now finds itself in more comfortable surroundings than ever before, the stock in such shape that it is easily accessible, and the employes working under conditions conducive to high efficiency.

Besides the Chicago house a branch house in San Francisco under charge of C. C. Hillis, assisted by F. J. Cram, carries a large stock. For over ten years a stock of staple supplies has been carried in Dallas, Tex., in charge of W. M. Brooke.

The company has made it a point to carry certain specialties besides staple electrical articles. These include Packard transformers and incandescent lamps, Paranite rubber-covered wire and Whitney instruments.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of improvement in retail trade are made, although the weather conditions are not yet settled. Agricultural progress is retarded somewhat by excessive rains, causing dealers to exercise conservatism. Confidence in the future, however, is the prevailing sentiment, and business in general will respond actively to more settled weather conditions. Manufacturing plants are busy, especially in heavy steel lines. In the iron and steel industry there is great activity on old orders, and general confidence in a vigorous demand during the second half of the year, but current buying is extremely light, except in a few departments. Hence, the mills and furnaces are more active than the markets just now, which explains the apparent contradiction of reports. Blowing out of furnaces for repairs indicates that the production has passed the maximum. Some piling of iron is reported in the Pittsburg district. In the cruder forms of finished material, such as structural rails and plates, business is still good and the output is heavy. Reports of the dissolution of the alleged steel-rail pool seem to have a political rather than a trade application, no particular effect on orders from railroads being noted. Nails and wire are reported in abundant supply in the hands of jobbers and retailers. Hardware is still active, though less is doing in some markets. Building material, such as lumber, paints and glass, are in active request. Southern lumber markets are strong and advancing. Anthracite coal is active, but bituminous is dull on large supplies. Off-grade coke is in buyer's favor. The cotton trade, after two years of depression and unsettlement, due to irregular or very high prices, is experiencing a revival. Woolen goods, on the other hand, are beginning to feel the influence of the great advance in raw material, and while popular lines of goods are selling well, others find the margin of profit between the raw and finished material a narrow one. Higher prices for woolens seem assured if the present prices for raw material hold, but pending a firm establishment on the new basis, irregularity is looked for. Shoe factories find difficulty in starting work on fall footwear, owing to numerous supplementary spring orders. Building operations make favorable comparisons with recent years, and there is little controversy regarding wages or hours of labor. Collections reflect little more than a seasonable slowness, and money is easy and in abundant supply. There is still abundant evidence that the country's consumptive requirements are on a large scale, heavily exceeding a year ago at this time. Railway earnings for the first half of May exceed a year ago by 6.5 per cent. *Bradstreet's* reports 179 business failures during the week ending May 25, against 191 the previous week, and 184 the corresponding week in 1904. In the metal market, copper was quiet, the activity of the week previous having subsided to a large extent. There was a firm undertone, however, in prices of 15c. for spot and early deliveries of Lake and electrolytic; casting grades are held at 14¾. Phenomenal exports are reported for the month of May up to the present writing, amounting to 18,377 tons, of which 6,300 tons go to the Orient.

COPPER MINING IN THE UNITED STATES.—The general conditions of copper mining in the United States are discussed by Walter Harvey Weed in a bulletin of the United States Geological Survey. The United States supplies about 60 per cent of the entire copper product of the world. The value of the output of copper for 1904 is estimated at $95,000,000. About two-thirds was exported in 1904. Our imports are practically all from Mexico and Canada. The profit of copper mining is shown by the fact that seventeen copper companies declared dividends during 1904 that aggregated $26,161,000. It is estimated that the production for 1904 exceeded that of 1903 by about 8.6 per cent, amounting approximately to 783,000,000 pounds. This increase is due mainly to Arizona mines, but the tremendous development in Utah, notably at Bingham and in the 'Frisco district, indicate that this State will soon take a more prominent place as a copper producer. At the present time the Boston and Montana mines of Butte are the greatest producers in the world. After them in productiveness come the Anaconda, Lake Superior and Rio Tinto mines, named in the order of their importance.

THE ALLIS-CHALMERS COMPANY, of Milwaukee, has secured the contract for furnishing for the Rhinelander Power Company, which proposes developing water power on Wisconsin River, the entire electrical equipment, which includes three 400-kw, 1,100-volt, three-phase, 60-cycle generators, with three 70½-kw, 120-volt separately-driven exciters, six 150-kw 10,000-volt transformers and complete switchboards at both the generating station and the substation at Rhinelander. The current will be transmitted at 11,000 volts over a three-phase circuit to the substation at Rhinelander, a distance of about 6½ miles.

THE STROMBERG-CARLSON TEL. MFG. CO., Rochester, N. Y., reports having closed contracts for switchboards for the followings places: Walker, Minn.; Susquehanna, Pa.; Coalville, Utah; Mt. Vernon, Ind.; Hayden, Ind.; Varlardena, Mexico; American Fork, Utah; Lyons, N. Y.; Columbus, Ohio; Atlantic, Iowa; Ishpeming, Mich.; Scotts Hill, Tenn.; Chinook, Mont.; Paris, Tenn.; Toronto, Ont.; Maquoketa, Iowa; Wray, Col.; Lowry, Minn.; San Antonio, Tex.; Guymon, Okla.; Rochester, N. Y.; Park City, Utah.

THE RIO DE JANEIRO TRAMWAY LIGHT & POWER COMPANY has outwitted the Brazilian Government, which had refused authorization of the plan to supply electricity to the Belgian concern known as the Rio de Janeiro Gas Company and through two of its representatives, F. S. Pearson and Percival Farquhar, has bought the interest of the Banque Liegeoise in the Rio de Janeiro Gas Company. The street railway, electric light and gas interests are now all in the control of the company.

MATERIAL FOR LIGHTING PLANT.—The contract for the electric light plant which the city of Troy, Mo., some few weeks ago, at a special election, voted bonds to the amount of $10,000 to build, was let May 26 to the following companies: Murray Iron Works Company of Burlington, Ia., installation of steam power, $2,900; Fort Wayne Electric Works, electric apparatus, $2,900; N. H. Ledford, of Bowling Green, Mo., complete electrical installations, $595.

NATIONAL-ACME MANUFACTURING COMPANY, of Cleveland, O., will shortly enlarge its manufacturing capacity by the addition of a four-story brick and steel extension to the main building. An improved market for "Acme automatics" both at home and abroad, together with a greatly increased demand for set and cap screws, has made more room an urgent necessity, and building operations will commence as soon as the structural material can be secured.

TELEPHONE CONDUITS.—Mr. Wm. D. Gherky, 344 N. Broad Street, Philadelphia, has recently closed contracts for installing conduit systems with the State Line Telephone Co., Peekskill, N. Y., and the West Maryland Telephone Company, Cumberland, Md. Work will be commenced immediately on both of these systems. Mr Gherky has also contracted to construct the foundations for the terminal of the new elevated road in West Philadelphia.

STANLEY-G. I. ORDERS.—The Stanley-G. I. Electric Manufacturing Company, of Pittsfield, Mass., reports the following contracts: City of Fort Valley, Ga., one 108-kw 60-cycle 2-phase 2,300-volt generator, with exciter and switchboard; 20 6.6 amperes, series alternating-current lamps, lighting transformers, etc. City of Hartford, Ala., one 80-kw 2-phase 2,300-volt 60-cycle generator, exciter and switchboard, arc lamps, lighting transformers, etc.

THE NATIONAL BATTERY COMPANY, of Buffalo, N. Y., has closed a contract with the Syracuse & Suburban Railroad Company of Syracuse, N. Y.,, to install a battery consisting of 240 cells of type W-9 unit accumulator in W-13 glass jars. This battery will be installed out on the line at DeWitt, to boost the voltage at that point, and help carry the heavy summer load. This installation is now under way.

LARGE ORDER FOR RHEOSTATS.—The Ward Leonard Electric Company, of Bronxville, N. Y., has received an order for 117 enameled field rheostats of one identical number designed for 220 volt capacity tapered from 2 to 1 amperes, 125 ohms resistance 8 inches diameter and 3 inches deep. This is said to be the largest single order ever placed for field rheostats of one type or catalogue number.

SUPPLIES FOR NAVY YARDS.—Bids will be received until June 20 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards at Mare Island, Cal., and Puget Sound, Wash., a quantity of supplies as follows: Incandescent and arc lamps, insulating rings, turbine pumps, forges, anvils, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

BIDS WANTED.—Bids will be received June 16 by the Board of Public Works for a 75-kw alternating-current generating set, consisting of engine, generator and transformers. Lewis A. Gorham, Grand Haven, Mich., is city clerk.

ELEVATOR BIDS.—Bids will be received until June 20 at the Treasury Department, Bureau of Engraving and Printing, Washington, D. C., for furnishing one electric elevator. Address Wm. E. Meredith, Director.

NON-ARCING LIGHTNING ARRESTER. — Last year the Franklin Institute, Philadelphia, Pa., awarded the Edward Longstreth medal of merit to H. M. Shaw, of Newark, N. J., for the invention of the non-arcing lightning arrester now becoming well known. The simplicity of this device, which is now on the market, will be apparent from the following description: The arrester is furnished with a plate of insulating material, to which flat metal ribbons are secured by screws, the latter serving also as binding posts for one stranded wire and one grounded wire. These ribbons project from the plate for a certain distance and are then bent parallel to the plate so as to have their serrated edges directly opposite. Between these serrated edges is placed a composite cylinder made up of alternating plates of non-arcing material, such as carbon and thin mica sheets. The carbon plates are mounted on insulating washers, and the mica plates extend down between these washers to a bolt made of some non-conducting material. The ends of this non-conducting bolt are attached to the metal ribbons. The lightning discharge finds entrance to the instrument by way of the stranded wire, passes through the first ribbon, and on reaching the serrated edge of this ribbon is broken up into small arcs and diverted to the flat carbon discs, which in turn break up the discharge into infinitesimal sparks. The latter are received at the serrated edge of the second ribbon and conducted to the ground. By thus sub-dividing the discharge its destructive effect is reduced to a minimum, while the resistance of the composite cylinder is so great that the line current cannot follow the static discharge. The complete instrument consists of the foregoing parts mounted in a substantial case having a removable front. The Shaw non-arcing arresters and dischargers are now being made and sold by the Shaw Engineering & Manufacturing Company, of Newark, N. J., with a sales department in the Flatiron Building, New York city.

DODGE & DAY, engineers and architects, Philadelphia, Pa., made a preliminary examination a short time since of the plant of the Link Belt Machinery Company, Chicago, Ill. As a result, they have been further commissioned to make a thorough examination of the mechanical and electrical features with a view of making a layout that will accomplish in the most economical and efficient manner the scheme of changes and improvements contemplated by the management. It is probable the power plant will be enlarged and considerable additional electrical equipment installed, as well as some new machine tools. This, however, will not be determined until the engineers have made their report.

OHIO BRASS COMPANY.—The Ohio Brass Company, of Mansfield, O., with regard to its recent fire, reports that its office and records, finishing and machine shops, insulating building, cooper shop and pattern vault all escaped the flames and that the majority of the force is actively at work. It says also. "In the near future the part of our plant which was destroyed will be rebuilt on a larger and better scale than the old one. We have also resumed manufacture of nearly all our products within the last day or two, and there will, therefore, be practically no delay in filling orders for any of our materials."

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was nervous and irregular, notwithstanding the favorable impression created in investing and speculative quarters of a definite harmonizing of differences between the Union Pacific and the Hill systems in the Northwest. Uncertainty about the crops, and political developments at Washington, also complicated the situation, although liquidation by overloaded speculators seems to be finished and the short interest is becoming excessive. Bonds have been firm, with a fair demand, due to easy money and its prospective continuance. The United States Steel shares were quite active, and though recovering somewhat from their recent low level, also seemed to be under pressure, in view of the continuance of adverse reports about iron-trade conditions at present, the formal dissolution of the steel-rail pool, which was one of the incidents, producing a certain adverse effect on sentiment in regard to these securities. The general list acted with a good deal of uniformity, both railroad and industrial stocks selling off sharply, recovering with more or less rapidity on Wednesday and Thursday, only to lose ground again and to manifest striking irregularity in the later dealings. Electric securities were somewhat irregular, the majority of them being on the downward turn. A prominent exception was Westinghouse, which was unusually active, making a net gain of 13 points. It closed at 165, which was the highest price of the week, and 12,200 shares were dealt in. General Electric came next in point of activity and strength, making a net gain of 4 points, the closing quotation being 173. Both issues of Allis-Chalmers are weak and little was done in them, the closing quotations being 13⅝ for the common, and 51 for preferred, these figures representing net losses of 1⅜ and ⅞ points, respectively. The railway shares were quiet, and all closed with losses. The last quotation of Brooklyn Rapid Transit was 57⅝, a loss of 1¾ points; Metropolitan Street Railway, 115½, loss ¼ point; Interborough Rapid Transit, 202, loss 1 point. In the telegraph group, Western Union closed at 92¾, which is a net gain of ¼-point; American Telegraph & Cable, 90½, a gain of ¾, and American Telephone & Telegraph, 138¼, a net decline of 1¾ points. Electric Storage Battery closed at 77, thus losing 3⅝ points net. The curb market was irregular, with some stocks a little higher and others lower, as compared with a week ago. Following are the closing quotations of May 29:

NEW YORK

	May 23	May 29		May 23	May 29
Allis-Chalmers Co.	13⅜	13⅛	Electric Vehicle pfd.	18	18
Allis-Chalmers Co. pfd.	50⅛	51	General Electric	169	172⅛
American Tel. & Cable	90	90	Hudson River Tel.	..	..
American Tel. & Tel.	136	138	Interborough Rap. Tran.	199⅛	200⅛
American Dist. Tel.	29	28½	Metropolitan St. Ry.	114⅜	116⅝
Brooklyn Rapid Transit	57⅛	61	N. Y. & N. J. Tel.	..	..
Commercial Cable	..	..	Marconi Tel.	..	..
Electric Boat	30	30	Western Union Tel.	92	92⅛
Electric Boat pfd.	73	74	Westinghouse com.	158	165
Electric Lead Reduction	..	..	Westinghouse pfd.	..	..
Electric Vehicle	12	12			

BOSTON

	May 23	May 29		May 23	May 29
American Tel. & Tel	137	138½	Western Tel. & Tel. pfd.	98	98
Cumberland Telephone	118¾	118⅝	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum.	245	*246	New England Telephone	*137	136¼
General Electric	168½	171½	Mass. Elec. Ry.	16	16
Western Tel. & Tel.	*18	*18	Mass. Elec. Ry. pfd.	58	59

PHILADELPHIA

	May 23	May 29		May 23	May 29
American Railways	51	51	Phila. Traction	100¼	..
Elec. Storage Battery	77	76	Phila. Electric	11¼	9⅞
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	31¾	30¾
Elec. Co. of America	11⅝	11¼			

CHICAGO

	May 23	May 29		May 23	May 29
Central Union Tel.	..	..	National Carbon pfd.	116	117
Chicago Edison	..	..	Metropolitan Elev. com.	22¼	22
Chicago City Ry.	190	190	Union Traction	..	..
Chicago Tel. Co.	134	..	Union Traction pfd.	..	..
National Carbon	55	60			

* Asked.

SPECULATION IN TROLLEY ENTERPRISES. — Not long ago there was trouble over undue trolley development in Ohio and Indiana. More recently Richmond, Va., has afforded a similar lesson against capitalizing the future, and now New England brings its warning in the failure of Burnett, Cummings & Co. The trolley is all right, but its ability to create traffic can easily be overestimated and overcapitalized. Advices from Boston say as to Burnett, Cummings & Co.: "The only surprise occasioned by the bankruptcy of Burnett, Cummings & Co. was that such action was not taken a year ago. This firm, which was a successor to Chas. S. Cummings & Co., and of which Mr. Cummings was the only member, built and floated the securities of the Middleboro, Wareham & Buzzards Bay, Bristol County, Lowell & Boston, Concord & Boston, and several other street railway properties. These roads were all heavily overcapitalized and never had any legal right to exist, as they never legitimately earned a dollar upon their capital. This firm also organized the Massachusetts Securities Company, a voluntary association, to hold the securities of their various street railways. This company had $91,000 of stock and $400,000 of collateral trust 5 per cent notes, which were secured by the floating debt notes of the various underlying properties. These roads came to grief a year ago. On May 3, 1904, receivers were appointed, and Burnett, Cummings & Co. were heavily involved, but no legal action was taken against them and they have been allowed to continue business. All the creditors of the firm have long charged off their losses, so that the failure is now without effect. Of the $1,700,000 liabilities $898,996 is given as 'secured.' The street railway companies appear as large unsecured creditors."

EARNINGS OF CHICAGO SUBWAY.—Officials of the Chicago Subway Company state that by the first of January next the company will be earning at the rate of $3,000,000 annually applicable to the stock or 6 per cent on the $50,000,000 issue. The company will then have in full operation 30 miles of tunnels and its full car equipment. President A. G. Wheeler says: "When the time comes we shall undoubtedly make regular earning reports. It can be stated, however, that the tonnage carried by us to date has more than fulfilled our advance approximations. We are exceedingly gratified. Our faith in the Subway as an enormous earner is stronger than ever, and by the first of January earnings should equal 6 per cent. on our stock. The Subway when completed will get all the tonnage it can handle and in its second year it should earn more than the Interborough in New York."

ELECTRIC LIGHT BONDS.—Bids are wanted until June 15 for $10,000 city electric light bonds at Burlington, N. C. Address O. F. Crowson, secretary, Burlington.

THE BRYANT ELECTRIC COMPANY, of Bridgeport, Conn., has increased its capital stock from $125,000 to $2,500,000.

General News of the Week

The Telephone.

ASHLAND, ALA.—Clay County Telephone Company has been chartered with a capital of $8000. The incorporators are Thomas Northern and others.

MENA, ARK.—The Mena & Smithville Telephone Company, of Mena, has been formed. The incorporators are I. D. Jones, C. A. Smith and others. Capital $5000.

ALTON, ILL.—The new telephone system of the Central Union Telephone Company in Alton has been placed in service.

ST. JOSEPH, ILL.—The Sidney Telephone Company has disposed of its line to the Douglas County Telephone Company.

ODELL, ILL.—The Odell Telephone Company has beeen formed with a capital of $2500. The incorporators are George Desvoigne, I. E. Desvoigne and others.

MASCOUTAH, ILL.—The Looking Glass Prairie Telephone Company has been formed, capital $2500. The incorporators are Henry V. Liebig and Fred J. Groul.

ULLIN, ILL.—The Ullin Telephone Company has been chartered with a capital of $2500. The incorporators are F. H. Holcomb, J. B. Mathis and others.

SHELBYVILLE, ILL.—The Cowden Mutual Telephone Company, organized by citizens of Cowden and vicinity, has received letters of incorporation. The papers name Zachary Hodson, Frank B. Bunn and James C. Hudson as incorporators.

PEORIA, ILL.—The Inter-State Telephone & Telegraph Company has opened its exchange in Peoria. The company now has 175 miles of underground conduits and occupies a new building erected by itself in the heart of the business district.

INDIANAPOLIS, IND.—The Central Union Telephone Company has removed all its telephones from the city offices, including the police station. The city refused to pay for the telephones, the contract having expired a year ago. These offices will now depend upon the one telephone system.

MILTON, IND.—The Milton Co-operative Telephone Company has incorporated. The capital stock is $10,000. The principal office and exchange will be in Milton. W. I. Doddridge, L. W. Beeson, W. E. Williams and W. A. Bragg are the incorporators.

SHELBYVILLE, IND.—The directors of the Mutual Telephone Company will let the contracts for an entire new plant to be constructed in this city. The plant will include an underground system. The 1120 lines to be laid will have a capacity of 4800 telephones. A lot will be purchased and a building erected for the exchange, which will include a power plant. The probable cost of the improvements will be $65,000.

DES MOINES, IA.—The Massena Independent Telephone Company has been formed by George J. Aistey and others. The capital stock is $10,000.

GRISWOLD, IA.—The Bond & Conklin Telephone Company has been formed; capital $10,000. The incorporators are F. M. Ronk and others.

VINCENNES, IA.—The Vincennes & Wayland Telephone Company has been formed with $3000 capital stock. The incorporators are G. L. Sargent, C. G. Freeman, Val Burke and others.

SIOUX CITY, IA.—The Iowa Telephone Company is putting into effect a new rate on its lines in Sioux City. It is now offering its patrons two party line service for the same price that four party line service had been given heretofore. In other words two party line telephones will be $2 a month instead of $2.50 as heretofore.

TERRIL, IA.—The Terril Co-operative Telephone Company, composed of local citizens, has bought the telephone system heretofore operated by the Midland Telephone Company, of Milford, and will take possession June 1. The officers of the local company are: President, D. A. Daniels; vice-president, T. J. Randolph; secretary, D. E. Neville; treasurer, W. C. Edmunds.

COUNCIL BLUFFS, IA.—Twenty-five independent telephone managers representing the exchanges of Western Iowa have met here with the promoters of the new system. The outsiders agreed to take $40,000 stock out of $100,000 in the Council Bluffs enterprise. All agreed to connect up with this city on copper wire toll lines. The local company is to have exclusive territory within a radius of 15 miles and may push farther where the field is unoccupied. Iowa toll line rules will govern.

HAZLETON, KAN.—The Barber County Telephone Company has been formed with a capital stock of $5000.

LIGONIER, KAN.—The Bell Telephone Company is preparing to build an exchange here with a capacity of 250 telephones. Heretofore there has been but a local toll station.

LAKE CHARLES, LA.—The franchise committee has reported favorably on the franchise asked for by W. E. Niles for a telephone system in Lake Charles and an ordinance on second reading passed unanimously.

MT. VERNON, ME.—The Mt. Vernon Telephone Company has been organized at Mt. Vernon for the purpose of doing a general telephone business in the towns of Mt. Vernon, Readfield, Fayette, Vienna and Rome, in Kennebec County, and the towns of Chesterville, New Sharon and Farmington, in Franklin County, with $5000 capital stock of which $1550 is paid in. The officers are: President, C. W. Mansur, of Mt. Vernon; treasurer, R. W. Leighton, of Mt. Vernon.

SAGINAW, MICH.—About $65,000 will be expended by the Michigan Telephone Company in improvement work in Saginaw.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company has acquired the plant of the Minnetonka Telephone Company and active measures are being taken to extend and improve both the plant and the service. Extensions are being made to Victoria and Christmas Lake.

ROUND KNOB, MO.—The Massac County Mutual Telephone Company, of this city, has been incorporated with a capital of $2400. The incorporators are George Vergbarg, Christ Korte and others.

ALTON, MO.—The Central Union Telephone Company is preparing to put into service a complete new telephone exchange in Alton, Upper Alton and North Alton, built at a cost of about $50,000.

ALBANY, N. Y.—The Dover Local Telephone Company has been incorporated. Its capital is $4000 and the directors are Sanford Hoag and Charles Hoag, Pawling, and Fred Coloman, Wing Station. The company will operate in the towns of Dutchess County.

CORTLAND, N. Y.—The Killawog Telephone Company has been incorporated with a capital stock of $18,000. The company will operate between Lisle, Broom and Preble in Cortland County. The principal directors of the company are J. Killawog, C. A. Baker, W. S. Dickenson, J. Sheralein.

WILMINGTON, N. C.—The Columbus Telephone Company, with principal office in Wilmington, has been granted a certificate of dissolution by the State.

CATHAY, N. D.—The Cathay Telephone Company has been formed by A. R. Josond, O. A. Bredo and others.

SHEYENNE, N. D.—The Sheyenne Telephone Exchange Company has been formed, capital $1000. The incorporators are H. W. Garnaas, J. W. Richter and others.

SULLIVAN, OHIO.—The Sullivan Telephone Company has just put in two new lines, and two more will soon be commenced.

CLEVELAND, OHIO.—The Ridge Telephone Company, of Washington township, has been formed by Wm. Alspach, J. Binker and others. Capital $275.

COLUMBUS, OHIO.—The Corning Elliott Telephone Company, of Morgan County, has been formed with a capital of $500. The incorporators are Elmer W. Gladden, Owen Gladden and others.

COLUMBUS, OHIO.—The Delaware County Telephone Company has been incorporated with a capital of $10,000. The incorporators are: President, T. R. Whittier; secretary, F. L. Ryant, and others.

ORWELL, OHIO.—A union of the farmer lines of township telephone companies has been perfected at Orwell. L. W. Lee, Rome, Ohio, was elected president; G. DeForest Gibbs, of Jefferson, Ohio, secretary; A. V. Case, Green, Ohio, vice-president. There are 18 companies and over 1280 telephones in the system, which makes free exchanges.

PERRY, OKLA.—The Lawnview Telephone Company of Perry, with a capital of $10,000, has been incorporated by B. J. Tucker, M. Jerome and others.

KENTON, OKLA.—A charter has been issued to the Kenton Telephone Company, of Kenton, Beaver County, with a capital of $2500. The incorporaters are John W. Turner, F. D. Drew and others.

GUTHRIE, OKLA.—The Oklahoma Northern Mutual Telephone Company of Grant County has been formed with headquarters in Hunnewell, Okla. The capital is $1000. The incorporators are J. W. Thompson, E. E. Tibbits and others.

RIETZ, PA.—The Central Telephone Company of Rietz will build a telephone line in Somerset. Capital $5000. The incorporators are John G. V. Reitz, Philip Reitz and others, of Buckstown.

WAVERLY, PA.—At a meeting of the stockholders of the Centremoreland and Northern Lackawanna telephone companies held in Waverly it was decided to consolidate the two companies under the name of the Commonwealth Telephone Company, which has already been chartered by the State.

PROVIDENCE, R. I.—Announcement of a material reduction in rates has been made at a meeting of the executive committee of the Providence Telephone Company. The changes to take effect June 1 apply to local service.

BELLE FOURCHE, S. D.—Bids will be received at the office of the Engineer, U. S. Reclamation Service, Belle Fourche, on June 26, for the construction of a telephone line about 16 miles in length and with 4 telephone stations.

MILBANK, S. D.—The Grant County Telephone Company, which was incorporated recently, is preparing to build its system. It has 300 subscribers. The officers of the company are H. Cunningham, president; Fred. Kruger, vice-president; W. G. Ackerman, secretary; F. B. Roberts, treasurer.

NASHVILLE, TENN.—The City Council has voted down a bill submitting to the people the ordinance granting the Home Telephone Company a franchise to build a conduit and telephone plant.

PALMYRA, VA.—The Virginia Central Telephone Company, of this city, has been formed; C. E. Jones, of Carysbrook, is president; L. O. Haden, of Palmyra, is secretary.

CEDAR GROVE, WIS.—The Cedar Grove Telephone Company has been formed with a capital of $3000. The incorporators are Adrian Fonteine and J. W. Meinen.

PARKERSBURG, W. VA.—The independent telephone companies of West Virginia at a meeting here have made arrangements to organize a mutual interchange of service with all independent companies throughout the State. Another phase of the situation discussed at the meeting was that of a State organization of the independent telephone lines.

Electric Light and Power.

FLORENCE, ALA.—Articles of incorporation of the Mussel Shoals Power Company have been filed with the office of the Probate Judge of Colbert County, at Tuscumbia. The officers of the company are Thomas H. Jackson, of Memphis, president; James Jackson, of Tuscumbia, vice-president, and John H. Harris, of Courtland, secretary and treasurer.

PRESCOTT, ARIZ.—The Arizona Power Company has been organized for the purpose of supplying electrical power within the bounds of Yavapai County, commercially, and at a cost that will make it an inducement for mines or any other business institution that will require power, to use its product. The company now has privileges for the development of power on Fossil Creek, about 25 miles east of Mayer.

ENGLAND, ARK.—The England electric plant has been started up. It belongs to the city.

WARREN, ARK.—The Warren Light & Water Company has been incorporated with a capital of $12,000. Fred. L. Purcell is president, and Carl Hollis, secretary.

SAN FRANCISCO, CAL.—The Ione Electric Light & Power Company has been incorporated in San Francisco by Charles Erickson, John Hancock, F. J. Solinsky, George Henry and Jackson Dennis, with a capital stock of $30,000.

VENTURA, CAL.—The town is to have another electric lighting plant, to be built by citizens as a speculation. They go into the matter with the probable intention of selling out to the town later, when the $25,000 of bonds recently voted are sold.

SIERRAVILLE, CAL.—The Sierra Valley Light & Power Company has begun digging a big ditch which will connect with the flume feeding its power plant. The ditch will be two miles long. It is the intention of the company to build an electric railway from Sattly to Sierraville and from there to Loyalton.

SAN FRANCISCO, CAL.—The Truckee Electric Light & Power Company's plant, at Truckee, Cal., has been destroyed by fire, causing a loss of over $10,000. The town was left in darkness, but a small generating unit was afterwards placed in condition to run while awaiting reconstruction of the main plant.

FRESNO, CAL.—The San Joaquin Light & Power Company has been incorporated with a capital of $3,000,000 by H. W. O'Melveny, of Los Angeles; Abraham Haas, of San Francisco, and others. It has taken over the plant of the San Joaquin Power Company at Fresno and proposes developing the water power of San Joaquin River and supplying Fresno and surrounding territory with light and power.

NEW CASTLE, COL.—The Henry Electrical Corporation, of Denver, has purchased the Peter Kinney electric light plant of this city and is overhauling the plant and remodeling it along more improved lines. New machinery throughout will be installed.

WALLINGFORD, CONN.—A resolution has been offered for the purpose of extending and enlarging the electric plant of the borough and utilizing the water power of the Quinnipiac River in the manufacture of electricity.

HARTFORD, CONN.—The committee on incorporations reported favorably on the resolution incorporating the Northern Connecticut Power Corporation. This corporation will acquire the water privileges in New Hartford known as the Greenwood water power.

TALLAPOOSA, GA.—The citizens have voted to grant Gelder & Black a franchise for an electric light plant.

FRANKFORT, IND.—The Indiana Hydraulic Company proposes to construct a cement dam on Sugar Creek in Park County, at a probable cost of work of $160,000.

FRANKFORT, IND.—The Indiana Hydraulic Company, recently incorporated, has selected a site 20 miles north of Terre Haute, at the mouth of Turkey Run. Wildcat Creek is inclosed here by sandstone bluffs 45 feet high. The company figures that a 30-foot dam here with 540 acres for back water will furnish abundant supply of water for power. The engineer says the dam will furnish a minimum of over 1000 horse-power and a maximum of from 1800 to 2000 horse-power. The company will have no trouble in finding a market for its electrical energy.

TOPEKA, KAN.—The Citizens Light, Heat & Power Company has been incorporated with a capital of $300,000 by J. J. Heim, of Kansas City; Arnold Kalman, of St. Paul, Minn.; Jas. L. Wolcott, of Dover, Del., and others.

AUGUSTA, KY.—Bids will be received until June 1 for a 20-year electric light franchise. W. C. Wittmeier is City Clerk.

BATON ROUGE, LA.—The Baton Rouge Electric & Gas Company has acquired the Capital Light & Power Company. Mr. C. H. Kretz has become general manager.

HAVERHILL, MASS.—The Haverhill Electric Company is to rebuild its plant on Water Street at a cost of $25,000.

NATICK, MASS.—The Selectmen have granted the Edison Electric Illuminating Company, of Boston, a franchise for the purpose of running its high-current lines from the Dover line to its local power station.

LYNN, MASS.—The Gas & Electric Light Commission has authorized the Lynn Gas & Electric Company to issue 2300 shares of new stock, at a value of $200 per share. Part of the proceeds is to be devoted to the payment of indebtedness and the balance to the plant.

PITTSFIELD, MASS.—The Stanley Company has recently received an order from the Oregon Water Power Company, of California, for $50,000 worth of generators and transformers. The Stanley plant is being run to its full capacity at present and has enough orders on hand to keep it busy for a long time to come.

LEOMINSTER, MASS.—At the annual town meeting, the town voted to light the streets by electricity the coming year. When the special town meeting to consider buying the Leominster Electric Light & Power Company's plant was called, the town voted against the municipal ownership of the electric lighting plant.

MUSKEGON, MICH.—A ten-year contract has been entered into between the Grand Rapids-Muskegon Water Power Electric Co. and the directors of the Interurban Railway Company for furnishing power for the propulsion of interurban cars. The Water Power Company proposes to expend $100,000 for machinery for the power station which it proposes to build at the dam now being constructed across the Muskegon River, near Rogers' bridge, about 6 miles directly south of Grand Rapids.

MINNEAPOLIS, MINN.—Articles of incorporation have been filed with the Secretary of State by the Hughes Electric Company, of Minneapolis; capital stock, $100,000. Incorporators: Alexander H. Hughes, of Minneapolis, E. A. Hughes, and W. V. Hughes, of Bismarck, N. D.

GREENVILLE, MISS.—A consolidation has been consummated whereby the Greenville Electric Light & Car Company was purchased by the Delta Light & Power Company. This throws the two lighting concerns of the city into one, to the mutual advantage of the citizens and rival light plants. The price paid was about $70,000.

LIVINGSTON, MONT.—President John L. Bright, of the Citizens' Electric Light Company, of this city, has purchased the controlling interest in the Livingston Electric Light Company.

DILLON, MONT.—The Dillon Electric Light & Power Company will on June 5 change management, the controlling interest of the plant having been sold by Dr. M. A. Miller, of this city, to H. W. Turner, of the Butte Electric Company.

DODGE, NEB.—It is reported that bids are wanted June 15 for the purchase of bonds, $8,000 for water works and $2,000 for an electric light plant.

KEARNEY, NEB.—Kuntzen & Isdell, of Kearney, have secured the contract for erecting a power house on the grounds of the State Normal School at Kearney for $9,283.

ALMA, NEB.—The date of opening of bids for constructing water works and an electric light plant has been extended from June 8 to June 22. M. A. Earl, Chicago, Ill., is the consulting engineer.

KEENE, N. H.—The contract for lighting the streets has been awarded to the Citizens Electric Company, of Keene, at $82.50 per year for each 410 watt arc light and $21 per year for 32-cp incandescent lights, for an all-night, every-night service.

JERSEY CITY, N. J.—The Ajax Light Company, of Jersey City, has been incorporated with a capital stock of $100,000. The incorporators are George M. Wormann, Daniel J. Clark and Harold Morford.

LOCKPORT, N. Y.—The Lockport Gas & Electric Light Company has filed at Albany a certificate of increase of capital stock from $150,000 to $300,000.

BUFFALO, N. Y.—The Niagara Gorge Power Company has been incorporated with a capital of $2,000,000. The directors are J. T. Jones, J. A. Jones, R. E. Powers and H. P. Bissell, of Buffalo.

CAZENOVIA, N. Y.—The Cazenovia Electric Company has been incorporated with a capital stock of $30,000. The directors are Henry Barden 2d, R. F. Hubbard, Cazenovia, and R. S. Brewster, New York.

ONEONTA, N. Y.—The Otsego Transmission Company, of Oneonta, has been incorporated with a capital stock of $40,000. The directors are John D. Capron, Menands, and William W. Capron and William H. Smith, Oneonta.

MINETTO, N. Y.—The Minetto Light, Heat & Power Company, of Minetto, has been incorporated with a capital stock of $20,000. The directors are C. B. Benson, Minetto; D. B. Page and T. A. Page, Oswego.

OSSINING, N. Y.—The Hudson Counties Gas & Electric Company, of Ossining, has been incorporated with a capital stock of $100,000. The directors are Moses Ely, A. F. Gotthold and R. R. Logan, New York.

POUGHKEEPSIE, N. Y.—The Dutchess Gas & Electric Company has been incorporated with a capital of $25,000. The incorporators are A. E. Seibert, James Cochrane, of Brooklyn, and W. R. Maloney, of Poughkeepsie.

BLASDELL, N. Y.—The Blasdell Electric Company has been incorporated with a capital stock of $50,000 to supply electricity for light, heat and power. The directors are J. B. Wall, M. M. Wall and T. H. Wall, of Buffalo.

ROCHESTER, N. Y.—The Manitou General Electric, Gas & Power Company, of Rochester, has been incorporated with a capital stock of $10,000. The directors are A. W. Moore, C. G. Moore and E. C. Smith, of Rochester.

NEW YORK, N. Y.—The United Public Service Corporation, of New York, has been incorporated with a capital stock of $500,000. The directors are Charles H. Gardner, George W. Peck and A. Edwin Schaffer, New York.

BATAVIA, N. Y.—The Genesee County Electric Light & Power & Gas Company, of Batavia, has been incorporated with a capital stock of $100,000. The directors are S. B. Storer, Syracuse; R. M. Walker and C. C. Bradley, Batavia.

NEW YORK, N. Y.—The Aurora Heat, Light & Power Company, of Richmond Borough, New York City, has been incorporated with a capital stock of $5000. The directors are J. E. McDonald, F. P. McDonald and E. O. McDonald.

NIAGARA FALLS, N. Y.—The Niagara & Eastern Power Transmission Company has been incorporated with a capital of $2,000,000. The directors are Henry B. Bodine, J. Gilmour Drayton, of Niagara Falls, and Addison H. Hinman, of Buffalo.

FISHKILL, N. Y.—The Southern Dutchess Gas & Electric Company, of Fishkill, has been incorporated with a capital stock of $25,000. The directors are J. T. Smith and E. L. Tompkins, Fishkill Landing, and S. K. Phillips, Matteawan.

SYRACUSE, N. Y.—The Oswego County Light & Power Company, of Syracuse, has been incorporated with a capital stock of $100,000 to supply gas and electricity. The directors are H. D. Brewster, A. D. Brown and S. A. Pulford, Syracuse, N. Y.

OSWEGO, N. Y.—The Oswego Light & Power Company has been incorporated with a capital of $100,000. Directors: Henry B. Brewster and Saml. A. Fulford, of Syracuse.

POTSDAM, N. Y.—Bonds to the amount of $40,000 are about to be sold, the proceeds to be used for the construction of an electric light plant. H. B. Sweet, of Utica, is the engineer.

BUFFALO, N. Y.—The Consumers' Power Company, of Buffalo, has been incorporated with a capital of $200,000. The directors are J. S. Lambert, of Fredonia, and Eugene L. Falk and F. H. Williams, of Buffalo.

WATERTOWN, N. Y.—The Jefferson County Gas & Electric Company, of Watertown, has been incorporated with a capital stock of $100,000. The directors are J. B. Taylor, F. B. Pitcher and B. J. McCarthy, Watertown.

TONAWANDA, N. Y.—A $500,000 mortgage is reported to have been made by the Niagara Light, Heat & Power Company of Tonawanda, to be used to take up outstanding bonds and make extensive improvements in Tonawanda.

BUFFALO, N. Y.—The Pioneer Gas & Electric Company, of Buffalo, has been incorporated with a capital stock of $300,000. The directors are William S. Carroll, G. L. Harris, F. V. Barnes, H. E. Martin and George Clinton, Jr., Buffalo.

ALBANY, N. Y.—The Albany, Susquehanna Valley & Binghamton Power Company, of Schenevus, has been incorporated with a capital stock of $75,000. The directors are M. E. Baldwin and John Graney, Schenevus, and George Brooks, Cooperstown.

ALBANY, N. Y.—The Empire Transmission Company, of Albany, has been incorporated to manufacture electricity for light, heat and power. The capital stock is $25,000 and the directors are J. P. Brooks, W. J. Hough, Albany, and Joseph A. Lawson, Menards.

BUFFALO, N. Y.—The Consumers' Power Company, of Buffalo, has been incorporated to supply electricity for light, heat and power. The capital stock is $200,000. The directors are J. S. Lambert, Fredonia; E. L. Falk and F. H. Williams, Buffalo.

UTICA, N. Y.—The Central New York Power Company, of Utica, has been incorporated with a capital stock of $1,000,000 to manufacture gas and electricity. The directors are William E. Lewis, Charles B. Warkins, Utica, and Harry S. Patton, Whitesborough.

BUFFALO, N. Y.—The New York & Lake Erie Power & Transmission Company, of Erie County, has been incorporated with a capital of $100,000 to supply gas and electricity. The directors of the company are J. F. Aldrich, G. A. Ricker, C. F. Powell, Buffalo.

BINGHAMTON, N. Y.—The Council has awarded to the Binghamton Light, Heat & Power Company, the contract for lighting the streets at 23c. per night for a term of 3 years for 374 arc lights, and for lighting the city hall and other city property at 6c. per kw-hour.

CASTLETON, N. Y.—The Castleton Light, Heat & Power Company, of Castleton, has been incorporated to operate in Schodack, Castleton, East Greenbush and Rensselaer. The capital stock is $25,000 and the directors are J. D. Smith, T. F. Clifford and F. H. McKnight, Castleton.

DEXTER, N. Y.—The Dexter Electric Light & Power Company has been incorporated at Albany to furnish light and power in various towns and villages of Jefferson County, capital, $100,000. Directors: Edward Hunter and Catherine J. Hunter, of Dexter; Celestin C. Burns and George H. Burns, of Watertown.

BUFFALO, N. Y.—The Western Counties Transmission Company, of Buffalo, has been incorporated with a capital of $2,000,000 to supply electricity in various counties of the State for light, heat and power purposes. The directors are R. W. Pomeroy, J. G. Dudley, H. T. Ramsdell, H. G. Meadows, C. L. Hurney, R. W. Chapin and L. B. Hart, of Buffalo.

MIDDLETOWN, N. Y.—E. R. and W. H. Sponsler will install at Middletown, N. Y., one 225-kw and one 350-kw Bullock generators. These are intended to supply power for the existing lines of the Middletown-Goshen Railway Company, together with its extensions, the whole of which will hereafter be known as the Walkill Transit Company. Mr. Frank G. Brown is the local engineer in charge of the plant. The Allis-Chalmers Company is building the generators at its electrical works in Cincinnati.

DUNN, N. C.—Contracts will be let after June 20 for enlarging the electric light plant at a cost of $2000. J. Pearsall is City Clerk.

REGINA, N. W. TER.—Bids will be received until June 19 by the City Corporation for $160,000 electric light bonds. J. Kelso Hunter is secretary and treasurer.

NEWARK, OHIO.—Electric light improvement bonds to the amount of $15,000 have been sold.

FOREST, OHIO.—It is proposed to construct an electric light plant here to cost from $5000 to $8000.

FREMONT, OHIO.—The Fremont Light & Power Company will develop the water power on Sandusky River near Fremont. It has retained H. von Schon, of Detroit, Mich., as consulting engineer.

KENTON, OHIO.—A deal has been closed whereby Richard G. Kerlin and E. M. Kerlin, of this city, come into possession of the local plant of the Kenton Gas & Electric Company, the consideration being $12,000. The Kerlin Brothers will spend about $50,000 in improvements.

WHITEMARSH, PA.—The Wissahickon Electric Company has been formed with a capital of $10,000 by Saml. S. Alderfer, of Souderton; J. Milton Brooke, of Edge Hill, and others, to supply light, heat and power in Whitemarsh Township.

ARMOUR, S. D.—Fred L. Kellogg has secured a franchise for a lighting and heating plant.

MILBANK, S. D.—There is an opening here for an electric light system. Mr. H. A. Martens could give further information.

WISE, TENN.—W. J. Jones is interested in the construction of an electric light plant.

PARSONS, TENN.—L. A. Rains and J. W. Fuller are reported interested in the construction of an electric light plant here.

BOLIVAR, TENN.—Bids are wanted June 15 for the construction of water works and an electric light plant, to cost $20,000.

CHATTANOOGA, TENN.—The City of Chattanooga has strongly supported, officially, the proposition of C. E. James and J. C. Guild to erect an electric power plant on the Tennessee River at a cost of $300,000. The capital needed is in sight and the company will be chartered in the State of Tennessee.

NORFOLK, VA.—The City of Norfolk has appointed a committee to investigate the cost of electric lighting in all cities east of the Alleghenies of forty or more thousand inhabitants, "to get reasonable rates for lighting and power in the city of Norfolk."

GREEN BAY, WIS.—The Green Bay Gas & Electric Company has decided to expend about $200,000 in improvements.

WAUWATOSA, WIS.—J. M. Harrison, of Milwaukee, has been selected by the County Board and Committee on Public Buildings to prepare plans and estimates for a central heat, light and pumping station for Wauwatosa.

CHILLIWACK, B. C.—People of Chilliwack have subscribed to $10,000 worth of stock of the Chilliwack Light & Power Company, and the residents of the valley have agreed to take a total of $25,000 worth of shares. The rest of the money for construction of the power plant will be raised in coast cities and in the East.

MONTREAL, QUE.—The West India Electric Company, of Montreal, has purchased the entire plant and business of the Jamaica Electric Light & Power Company, doing business in the City of Kingston, Jamaica. By this purchase the Canadian company obtains the entire control of the electric traction and lighting in Kingston and lower St. Andrew. The price paid was nearly $80,000.

The Electric Railway.

SAN JOSE, CAL.—A resolution has been passed granting a franchise to build an electric railway from some point on Monterey Bay through Watsonville and San Juan to Hollister, as applied for by W. W. Gibson, of San Francisco.

LOS ANGELES, CAL.—The Southern Pacific has discontinued 25 regular passenger trains between Los Angeles and suburban points, as a direct result of the competition of the electric railways. The lines affected are those to Santa Monica, San Pedro, Long Beach and Whittier, and only one regular passenger train will be run daily between Los Angeles and these points. Officers of the road say that for 18 months passenger trains have been run at a loss.

ATLANTA, GA.—The Tennessee-Alabama Interurban Electric Railway, chartered recently under the laws of Georgia, with $300,000 authorized capital, has been granted the right by the Secretary of War to build through Chickamauga Park.

BUNKER HILL, ILL.—The St. Louis & Eastern Electric Railroad Company, which has applied for incorporation papers and intends to build a line from East Alton to Litchfield, has elected the following-named officers: President, J. H. Belt, Jr., of Bunker Hill; vice-president, George A. Kline, of Bethaldo; secretary, H. R. Budd; treasurer, C. E. Drew.

JACKSONVILLE, ILL.—W. B. McKinley, representing the Illinois Traction Company, May 18, closed negotiations with the Jacksonville Gas, Electric Light & Coke Company, taking over the ownership of the corporation for $200,000. A few days ago, the syndicate bought the City Railway. Possession was taken May 18. Improvements will be made at a cost of $75,000.

FORT WAYNE, IND.—The contract for the power house equipment for the Fort Wayne & Wabash Valley interurban and city traction lines has been awarded to the Westinghouse Elec. & Mfg. Company, in competition with the General Electric Company. The power house will be equipped with turbogenerators which will develop 6000 horse-opwer. Work on the construction of the power house will begin immediately.

CHICKASHA, I. T.—The City Council has granted a franchise to Julius E. Wright, S. Howard Leach and J. A. Bohart to build an electric railway in this city; also to several nearby towns and eventually to Oklahoma City.

ALEXANDRIA, LA.—The Board of Aldermen has granted a franchise to T. G. Bush, of Mobile, Ala., to construct and operate an electric street car line in this city.

MONROE, LA.—The City Council has awarded the contract for the construction and equipment of the electric street railway to the Western Electrical Construction Company, of St. Louis, for $100,000. There will be about six and one-half miles of track. The contracts for the supplies and material were awarded a few days ago.

BANGOR, ME.—The directors of the Penobscot Central Railway have decided to discontinue operations June 3, until such a time as some means can be found to put the road on a paying basis. The company operates an electric railway to Charleston, a distance of 25 miles.

BOSTON, MASS.—Stone & Webster deny that there is any foundation whatever in the rumor that Col. W. C. Greene has purchased all or a part of their street railway interests in El Paso, Tex. There has been no change in the ownership of the property and none is contemplated.

BOSTON, MASS.—The Boston & Northern Street Railway has petitioned the railroad commissioners for authority to issue $500,000 mortgage bonds and the Old Colony Street Railway Company has also petitioned the commissioners for authority to issue $500,000 mortgage bonds, the proceeds of the issues to be used in additions and extensions to the properties.

BENTON HARBOR, MICH.—Right of way has been secured by the St. Joseph River Traction Company for an electric railway between this city and Kalamazoo.

MONROE, MICH.—The Westinghouse Electric & Manufacturing Company is getting out plans and estimates for the construction of a 17-mile electric railway from Monroe to Dundee to serve as a feeder to the Detroit, Monroe & Toledo Short Line.

GRAND RAPIDS, MICH.—The Grand Rapids, Grand Haven & Muskegon Interurban Railway Company has closed a 10-year contract with the newly organized Grand Rapids & Muskegon Water Power & Electric Company for from 700 to 1000 horse-power for the operation of the road. Large dams are being built on the Muskegon River between Big Rapids and Stanwood and the power plant will be completed and in operation Dec. 1, when the Interurban will begin to use the power.

MOORHEAD, MINN.—S. W. Wheeler, Moorhead, is at work interesting eastern capital in a 90-mile electric railway to run from Crookston to Grand Forks and Fargo.

HAVRE, MONT.—Dr. Ernest Crutcher, of Great Falls, Mont., has secured a franchise for a system of electric railways in Cascade County, Mont.

HANNIBAL, MO.—The movement looking to the building of the electric railway from Hannibal to Kirksville, Mo., is assuming form. Messrs. Ogden and Carter, the promotors, who have Eastern capital interested in the project, held a meeting at Kirksville a few days ago at which assurance was given that support would be given the enterprise. The proposed route is 80 miles long.

CAMDEN, N. J.—At the annual meeting of the South Jersey Gas & Electric Traction Company, held here a few days ago, the following-named officers were elected: President, A. R. Kuser; vice-president, William J. Bradley; secretary, Fred Evans; treasurer, Charles G. Cook.

MARCELLUS, N. Y.—The Marcellus & Otis Co. Lake Railway Company has been incorporated with a capital stock of $200,000. This company is a reorganization of the Marcellus electric railway. The directors are G. M. Brill, Merion, Pa.; S. S. Marvin, Bryn Mawr, Pa., and H. R. Bayne, New Brighton.

BATAVIA, N. Y.—The Union Traction Company has been organized to build an electric railway from Batavia to Lake Ontario. The State consents have been given, rights of way and some franchises have been secured. The total length of the proposed road is 48 miles. The authorized capital of the company is $600,000.

NEW YORK, N. Y.—Attorney-General Mayer, of New York, has denied the application made by Anthony Stumpf, a stockholder, in the New York & Port Chester Railroad, through his attorneys, asking that action be brought in the name of the State to obtain a judgment that the New York, Westchester & Boston Railroad never existed and never acquired the right, privilege or franchise to construct, operate or maintain a railroad. The case at issue has been before the public in various phases for a number of years, during which the Westchester has never acted on its franchise, while the Port Chester, possessing all other necessary consents, has been held up by the Board of Aldermen.

NEW YORK, N. Y.—Fourteenth Street has been formally decided upon as the route for the second crosstown subway by the Rapid Transit Commission. Thirty-fourth Street was decided upon as the route for the first at the meeting last week. The sub subway, as planned, will extend from the North River straight across Fourteenth Street as a four-track route to a point between Avenues B and C where the connection will be made with a bridge loop, which is to connect the Williamsburg, Manhattan and Brooklyn Bridges. This loop will tunnel the East River to Williamsburg opposite Fourteenth Street. The Fourteenth Street line will have two spurs running down the West Side. One will run from Ninth Avenue, two tracks, through Ninth Avenue, Greenwich Street, Liberty and William Streets to the proposed Old Slip tunnel under the East River to Brooklyn. The other will carry two tracks down University Place, Wooster, Canal and Centre Streets, to connect at Brooklyn Bridge with the so-called bridge loop.

ST. CLAIRSVILLE, OHIO.—Local people are promoting an electric railway from St. Clairsville to Barnesville.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway is preparing to build an extension from New Castle to West Pittsburg, Pa.

FREMONT, OHIO.—J. N. Gardner, of New York, is at the head of a projected electric railway to be known as the Columbus, Fremont & Lake Erie Railway. It is the intention to build from Marion to Lake Erie by way of Upper Sandusky, Tiffin and Fremont.

WILMINGTON, OHIO.—The Wilmington, Jamestown & South Solon Railway Company has been incorporated by A. J. Wilson, B. F. Patterson, J. V. Baird, M. R. Denver, S. G. West and others. It is proposed to build a line form Wilmington to Jamestown and South Solon.

NORWALK, OHIO.—The Westinghouse Electric & Manufacturing Company is preparing plans for the construction and equipment of the proposed Mansfield, Greenwich & Norwalk Railway. The Sandusky, Norwalk & Mansfield Railway, which is under construction, will run to Mansfield by way of Plymouth.

COLUMBUS, OHIO.—At the annual meeting of the stockholders of the Columbus, Newark & Zanesville Electric Railway Company the following-named officers were elected: President, P. L. Saltonstall; vice-president, S. Reed Anthony; secretary, C. C. Williams; treasurer, Chauncey Eldridge; assistant treasurer, Nathan Anthony.

CANTON, OHIO.—The Canton & Youngstown Railway Company, which proposes to build from Canton to Youngstown, has applied for a franchise in Canton. The officers of the new company are: President, W. H. Clark; vice-president, J. R. Snyder; secretary, L. D. Blanchard; treasurer, C. H. Schlaback; attorney, J. E. Monnet, all Canton men.

COLUMBUS, OHIO.—The annual stockholders' meeting of the Columbus, Buckeye Lake & Newark Traction Company was held a few days ago and resulted in the election of the following officers: President, S. Reed Anthony; vice-president, P. L. Saltonstall; secretary, C. C. Williams; treasurer, Chauncey Eldridge; assistant treasurer, Nathan Anthony.

COLUMBUS, OHIO.—The steam roads out of Columbus have taken concerted action to compete with the electric roads out of this city. All but the Pennsylvania Company have agreed to meet the rates of the interurbans to competing points. The Pennsylvania officials investigated the matter and decided that it would not be profitable to fight the interurbans.

YOUNGSTOWN, OHIO.—The directors of the Youngstown & Mahoning Valley Railway Company, the Youngstown & Sharon Railway & Light Company and the Sharon & New Castle Railway Company are reported to have agreed upon the terms of the proposed consolidation of the properties and the proposition will be presented to stockholders of the various companies at an early date.

AKRON, OHIO.—In addition to the 500-kw Curtis turbo-generator now being installed at its Akron power station, the Northern Ohio Traction & Light Company is installing another 500-kw generator which will be used as a booster to supply the Barberton division, thus enabling the company to shut down the old Barberton power station. A battery of Sterling boilers is also being installed.

MANSFIELD, OHIO.—The Wooster & Mansfield Interurban Railway Company, which proposes to build from Mansfield to Wooster, is considering the advisability of using gasoline motor cars. It is thought the road can be built and equipped in this manner for $700,000, whereas the engineers' estmiates for electrical equipment are $1,079,000. David Collier, of Mansfield, is at the head of the company.

YOUNGSTOWN, OHIO.—The stock held by the promoters of the Youngstown & Southern Railway Company has been purchased by a syndicate composed of Youngstown men. The road will now be completed as an interurban electric. The company has been operating about 16 miles of track by steam for the past six months. Work will be commenced in a short time on a line which when completed will connect East Liverpool, Salem, Lisbon and Lectonia with Youngstown. At Salem a connection with the Stark Electric will make it possible to go from Youngstown to Cleveland by trolley. John Stambaugh, Youngstown, is president; C. P. Phelps, New York, vice-president; S. J. Dill, Youngstown, second vice-president; F. D. Wilkerson, Youngstown, secretary and treasurer; E. L. Lincoln, Youngstown, assistant treasurer.

OKLAHOMA CITY, OKLA.—A charter has been issued to the Oklahoma Traction Company, with headquarters at Oklahoma City and a capital stock of $300,000. The stockholders are C. E. V. Eggleston and S. G. Glasgow, of Oklahoma City; C. R. Eggleston, of Fort Smith, Ark.; L. E. Patterson, of Ada, I. T., and T. D. Woodsen, of Alva.

ALLENTOWN, PA.—Frank Jacobs has been appointed master to sell the Allentown & Slatington Electric Railway under foreclosure proceedings. The price is fixed at $275,000, bidders to deposit certified checks for $10,000.

TOWANDA, PA.—The organization of the Chatham & Wallaceburg Electric Railway Company has been effected with G. W. Kipps, of this town, president, treasurer and general superintendent. The directors are G. W. Kipp, E. F. Kiser, M. E. Lilly and S. F. Robinson, of Towanda, J. O. Keefe, D. S. Gordon and H. N. Stevens, of Canada.

DAVENPORT, WASH.—The Big Bend Traction Company, which proposes to construct a line from Davenport northward to the Columbia River, has just been organized by John Sawyer, J. W. Fry and Charles Turner. W. H. Plummer promoter of another concern, the Spokane & Big Bend Traction Company, told the Davenport board of trade that $100,000 of the stock had been subscribed in Spokane, and that if Lincoln County would take the same amount the road would be bonded and work begun within 60 days. The Adams County Transit Company was organized by Cal Lunceford and Ritzville associates. It was proposed to get power by building a dam at the Narrows in the Spokane River near its mouth.

ST. CATHERINES, ONT.—The Canada-Middlesex Company is seeking incorporation by the Dominion Government to build an electric railway from the Niagara frontier through St. Catherines, Woodstock and London to Brantford.

New Industrial Companies.

THE ABERDEEN ELEVATOR COMPANY, of Hamilton, Ont., has been incorporated to carry on a general warehouse business and generate electric power and light. Capital $50,000.

THE MAJESTIC AUTOMOBILE COMPANY, of New York, has been incorporated with a capital stock of $50,000. The directors are G. H. Mulligan, Emily C. Mulligan and W. J. Greene, New York.

THE MOSHER WATER TUBE COMPANY, of Harrison, N. J., has been incorporated with a capital stock of $1,000,000. The incorporators are G. C. Sims, A. S. Beves and Charles D. Mosher.

THE VANADIUM ALLOYS COMPANY, of New York City, has been incorporated with a capital stock of $100,000. The directors are G. A. Burkard, Albert Foster and Hattie Danhauser, New York.

THE ELECTRIC COKE COMPANY, of New York, has been incorporated with a capital stock of $20,000. The directors are F. B. Adams, New York; A. L. Brougham and Jackson Wallace, Brooklyn.

THE EVANSVILLE BATTERY & ELECTRIC COMPANY has been formed, capital $100,000. The directors are Willis M. Copeland, Albert F. Karges, John C. Zutt, Louis A. Dins and Henry C. Porter.

THE HAVANA AUTOMOBILE COMPANY, of Paterson, N. J., has been incorporated with a capital stock of $300,000. The incorporators are William Shek, Jr., Louis H. Pink and Walter Moffat.

THE MERCANTILE BURGLAR ALARM COMPANY, of New York City, has been incorporated with a capital stock of $5000. The directors are T. H. Boardman, Yonkers; J. J. Young and W. B. Sheppard, New York.

THE RITZER MANUFACTURING COMPANY, of Oneonta, N. Y., has been incorporated with a capital of $10,000 to carry on a general electrical

business. The directors are W. H. Smith, D. B. Manchester and W. W. Capron, Oneonta.

THE GENERAL TRANSMISSION COMPANY has been incorporated at Buffalo, N. Y., with a capital of $15,000,000. The directors are James D. Ferris, Robert A. Teepell, Fred E. Pond, Byron L. Moore, of Buffalo, and Hugh Taylor, of East Aurora.

THE HYDROTHERM ELECTRICAL COMPANY, of Jersey City, has been incorporated with a capital stock of $1,000,000. The incorporators are L. D. Winton, E. M. Treat, Charles F. Bates, Robert E. Williams, S. M. Heil, Edward Sills, C. T. Westlake and T. T. Price.

THE AUTOMATIC TOOL COMPANY, of Norwalk, has been formed to deal in autos, motors, electrical fittings, and to do a mechanical business; capital, $20,000. The incorporators are: Elbert N. Sipperley and Elbert N. Sipperley, Jr., of Westport, and Charles H. Jimmerson, of Norwalk.

Legal.

THE CHICAGO TELEPHONE COMPANY has won the last rebate suit brought against it by the Illinois Glass Company in Judge Holdom's court. The jury returned a verdict in favor of the defendant company. The court's instructions were that as there was no duress shown, the plaintiff could not recover a rebate of $50 a year for five years from the telephone company, which was the amount for which it was suing.

HUDSON RIVER VALLEY RAILWAY.—Justice Henry T. Kellogg has appointed District Attorney Jarvis P. O'Brien, of Troy, N. Y., receiver of the Hudson Valley Railway Company. Mr. Halpin sued the Hudson Valley Railway Company and the Merchants' Trust Company of New York to foreclose on 45 bonds of the railway company which he holds and which are secured by a mortgage given to the Merchants' Trust Company. The receiver's bond is fixed at $100,000. George R. Salisbury, of Saratoga, is appointed referee in the proceedings to sell the railway after it has been advertised for six weeks. Justice Kellogg provides that any bondholder or creditor who has a lien may participate in the judgment. The trust company is the principal creditor. The railway has 20 days to pay off the claim.

WRONGFUL DEATH FROM ELECTRICITY.—In an appeal to the Court of Appeals of Maryland in an action of the United Electric Light & Power Company of Baltimore versus the State to use of Lusby et al. it was held: 1. In an action for the death of a person coming in contact with a live wire belonging to defendant, because of its contact with a telephone wire, evidence that defendant's wires were defective at other times and places is inadmissible. 2. On the question of damages in an action for wrongful death, evidence as to the earning capacity of deceased is admissible. 3. Questions of expert witnesses, which assume facts that have not been proven in the case, are erroneous. 4. An action for wrongful death cannot be maintained without proof of negligence on the part of defendant, the mere fact of an accident not being sufficient.

SUIT OVER APPARATUS.—An action was begun last week in the United States Circuit Court, New York City, by the Westinghouse Electric & Manufacturing Company against the Manhattan Railway Company to recover $371,475, which, it is alleged, is due on contracts entered into. The complaint recites that in February, 1900, the Manhattan Company contracted for the erection of an electrical plant in its power house in New York, consisting of 26 converters and 78 transformers, with dynamos and other appliances, the contract price of which was $1,296,769. All of this sum has been paid, it is admitted, excepting a balance of $235,965, which is demanded with interest from February, 1903. The power being insufficient, a supplemental contract was made, it is also alleged, for additional machinery, upon which there is still due $16,646; for other apparatus installed in the defendant's sub-stations the plaintiff wants $100,863, or the sum of $371,475 in all.

TELEPHONES FOR GAMBLING.—The matter of E. Bayer versus the New York Telephone Company in the Supreme Court of the State of New York, County of New York, has been decided in favor of the company, for whom Mr. John H. Cahill appeared. In this case Emil Bayer applied to Justice Samuel Greenbaum for a mandamus requiring the New York Telephone Company to furnish telephone service to him at No. 1285 Broadway, New York, where he said he was engaged in the business of furnishing "news of all descriptions to athletic association, hotels, etc." The company had refused his request of service on the ground that his place had been raided by the police, who removed the telephones then there and arrested several persons on the charge of betting on horse races, etc., in violation of Section 351 of the Penal Code. Although unable to convict these persons so arrested, who were promptly discharged by the police magistrate, before whom they were arraigned, the police officials in affidavits made in opposition to the application for a mandamus, alleged facts indicating the truth of their charges that the law mentioned had been violated, and asserted their opinion that if the telephones were re-connected they would be used for the purpose of aiding the commission of the crime referred to. The mandamus case was argued by the above-named counsel, respectively, and Justice Greenbaum rendered the following decision: "The opposing affidavits show that the telephones were originally removed by the police under circumstances establishing that they were used for the purpose of selling pools in violation of Section 351 of the Penal Code. Mandamus will not lie upon such a showing. Motion denied with ten dollars costs."

INJURY TO LIGHTING CUSTOMER.—In an appeal to the Sixth Circuit Court of Appeals of Tennessee it has been held that where a customer of an electric light company was killed while turning on a light in the house by the crossing of the primary and secondary wires at the transformer in the street, the jury in the absence of explanation may infer negligence from the happening of the accident through the wires were properly installed, but the court is not required to say whether it should be presumed. The question as to what kind of flexible cord was used was immaterial. On May 19, 1903, J. J. Letson, a resident of Memphis, Tenn., was instantly killed by an electric shock received while turning on a 16-candle power incandescent lamp in the basement of his house. The lamp was a portable one, being attached to a flexible cord. The deceased had been since September 7, 1901, a patron of the Memphis Consolidated Gas & Electric Company, which had contracted to furnish him, for illuminating purposes, with a current of 104 volts to supply twenty 16 candle power incandescent lamps. An examination made shortly after the accident disclosed the fact that the primary wire had become crossed with the secondary wire on the outside of the transformer on the pole, the insulation had worn off, an electrical contact or "cross" had been established, and the current of approximately 2300 volts was being transmitted directly into the residence without passing through the transformer at all. Mr. Letson, having occasion to use the lamp, seized it at the socket and turned the button, and the current passed through his body, killing him instantly. A neighbor who was present and attempted to release him was shocked and slightly burned. The suit was brought under the Tennessee statute by the widow, on behalf of herself and infant son. The electric company was charged with negligence in permitting the deadly current to pass into the residence of the deceased. The jury returned a verdict for $13,750.

Obituary.

FRANKLIN LEONARD WAINWRIGHT POPE, son of the late Franklin Leonard Pope, and nephew of Ralph W. Pope, secretary of the American Institute of Electrical Engineers, died at the home of his sister, Mrs. Geo. W. Shirk, at Cornwall, N. Y., on May 27. Mr. Pope was born in Elizabeth, N. J., July 29, 1880, and graduated from Amherst College in 1903. He was on the signal engineering staff of the Pennsylvania Railroad, but failing health compelled him to resign in September, 1904. He spent the winter at Saranac Lake, but the change was not beneficial. Mr. Pope was greatly interested in railroad work, and gave every promise of a brilliant future.

Personal.

MR. WILLARD W. LOW, president, and Mr. Thomas I. Stacey, secretary and treasurer of the Electric Appliance Company, of Chicago, which company has recently been undergoing a remarkable expansion, as noted elsewhere in this issue, were 15 years ago a couple of young men in the employ of the Central Electric Company, who believed that there was room for another electrical supply house in the Middle West. Mr. Low had been with the sales department of the old Detroit Electrical Works, previous to 1888, when he resigned to go with the Central Electric Company at Chicago. Mr. Stacey's connection with the Central began a year earlier. In 1891 Messrs.

MR. WILLARD W. LOW.

MR. THOMAS I. STACEY.

Stacey and Low became convinced that there was a good chance for another supply house on definite new lines, and they started the Electric Appliance Company, whose fifth expansion in the course of 15 years is just chronicled. Mr. Low is undoubtedly one of the best known men in the mercantile branch of the electrical industry in the United States to-day. He has looked after the outside interests of the company, while the workings of the business machinery of the house have been under the watchful care of Mr. Stacey. In these two gentlemen there is the combination of business and selling ability that is necessary to the greatest success of any company.

MR. H. J. EDWARDS has been appointed general manager of the United Gas & Electric Company's stations at San Jose, Cal., succeeding Mr. C. H. Pennoyer.

MR. A. GOLDSCHMIDT, formerly city electrician of Davenport, Ia., has been placed in charge of the electrical department of the Davenport Gas & Electric Company.

MR. J. ROBERT CROUSE, of the National Lamp Company, and the Lamp Manufacturers' Association, has been visiting New York City the past week in connection with the development of the lamp industry.

MR. W. G. CLARK, manager of the Kilbourne & Clark Company, of San Francisco and Seattle, coast representatives of the National Electric Company, of Milwaukee, recently visited San Francisco on his return from New York.

MR. LOUIS J. AUERBACHER, electrical engineer of R. A. Schoenberg & Co., has returned from a trip to Europe, during which he investigated the latest developments there in electric lighting and in details of interior installation.

MR. THEODORE WATERS has begun in the June number of *Pearson's Magasine* a series of interesting articles on "The Profession of Getting Hurt." Mr. Waters exposes the varied methods of accident fakirs, most of which are only too well known to the street railway manager.

MR. FRANK J. SPRAGUE with his wife and a large party of friends sailed last week on the Atlantic transport liner *Minnetonka* for England and the Continent. He will be abroad for professional work and recreation until the early Fall, and will give special attention to the development of heavy electric traction on the other side.

MR. M. A. MAXWELL, who has been for several years superintendent of the lighting and power plants of the Easton Power Company, Easton, Pa., has entered into partnership with M. A. B. Beadle, formerly with the United Gas Improvement Company, of Philadelphia. The firm name will be Beadle & Maxwell, with offices at 82 Beaver Street, New York. It will make a special feature of consulting, contracting and development work for lighting and power plants, gas, electric and water.

MR. JAMES DALRYMPLE, superintendent of the city tramway system of Glasgow, Scotland, arrived here last week on the steamship *Campania*. He is going to Chicago in response to the invitation of Mayor Dunne, of Chicago, to advise the officials of that city in their experiment with municipal ownership. Mr. Dalrymple was received with brass bands and colored fires, and could not quite make out what it was all about. He will know later when he has sized up the politicians of Chicago.

CHANDLER-BERARD.—Dr. Charles F. Chandler, the distinguished chemist, who was formerly president of the New York Board of Health and has for many years been professor of chemistry at Columbia University, was married last week to Miss Augusta Polhemus Bérard, of New Hartford, Conn. The bride is a daughter of Mrs. J. Charles Bérard, and the ceremony was performed in the Bérard homestead at New Hartford. The Rev. E. H. Dickenson, of the First Presbyterian Church, Buffalo, a cousin of the bride, officiated. Among those present were Prof. Pupin and Prof. Crocker, long time personal friends of the popular head of chemical studies at Columbia. Prof. Chandler is 69 years of age; the bride is much younger. Prof. Chandler's first wife died years ago. Mrs. Charles E. Pellew is his daughter.

MR. JAMES STRASBURG, who until recently has been connected with the Automatic Electric Company, of Chicago, has accepted a position as representative in the sales department of Frank B. Cook, the well-known manufacturer of protective apparatus. Mr. Strasburg is a Chicago man, and received his early education there. He later went to the University of Michigan, where he graduated with high honors. He was connected with the Automatic Electric Company for about three years, and during this time was engaged in installing a number of plants for the company. During the last summer he was in charge of the Automatic Electric Company's exhibit at the World's Fair in St. Louis. Mr. Strasburg's training and experience as a telephone man well fit him for the new work which he has taken up.

DR. C. A. DOREMUS and his brother, Mr. A. L. Doremus, secretary of the Crocker-Wheeler Company, have sustained a severe bereavement in the death of their mother, Mrs. R. O. Doremus, wife of Prof. R. Ogden Doremus, of this city, and for many years a distinguished leader in the social and intellectual life of New York City. Mrs. Doremus was born on May 6, 1830, in New York. She was married to Prof. Doremus on Oct. 1, 1850. She was the daughter of Capt. Hubbard Skidmore, and was said to be the only member of the New York Chapter of the Daughters of the American Revolution whose father actually served in the Revolution. She was a Regent of the New York Chapter and honorary vice-president of the National Society. She was recently re-elected president of the Underhill Society of America. She was a descendant of the Underhills, who received much of their land on Long Island by cession from the Pequots.

MR. E. M. HERR.—The announcement that Mr. E. M. Herr, general manager of the Westinghouse Air Brake Company, has been appointed first vice-president of the Westinghouse Electric & Mfg. Company, will be the subject of much congratulatory comment in the railroad and engineering professions. Mr. E. M. Herr began his career as a messenger boy for the Western Union Telegraph Company at Denver, Colo., afterward becoming an expert telegraph operator in commercial work. He later became station master and operator at the Deer Trail station of what is now the Union Pacific Railway. After a short time in this service he arranged to attend the Sheffield Scientific School of Yale, obtaining his engineering degree from this university. Upon leaving college he went to the Chicago, Milwaukee & St. Paul Railway as special apprentice in the motive power department at West Milwaukee. Later he went to the motive power department of the Chicago, Burlington & Quincy road as mechanical draftsman and engineer of tests, where, owing to his former experience in telegraphy, he was made superintendent of telegraph of the system. His splendid work in this department, especially during the Burlington strike, brought him to the attention of the operating department, whereupon he was made division superintendent of the lines east of the Missouri River. In 1889 he went to the Chicago, Milwaukee & St. Paul as master mechanic, which position he held until 1892, when he was called to the superintendency of the Grant Locomotive Works, at Chicago. He was later sent to Europe by financial interests to report upon and establish a locomotive building plant in Russia. Upon the completion of this important mission he returned to America, and in 1896 became general manager of the Gibbs Electric Company, at Milwaukee, which company was afterwards purchased by the Westinghouse Company. Soon after his connection with the Gibbs Company he resigned to become assistant superintendent of motive power of the Chicago & North western, under Robert Quayle. In 1897 he went to St. Paul as superintendent of motive power on the Northern Pacific, which position he retained until 1899, when he was called to Pittsburg as assistant general manager of the Westinghouse Air Brake Company. Due to his marked ability as an engineer, works manager and executive, he was promoted to the position of general manager of this company. Mr. Herr is about 45 years of age. The organization of the Westinghouse Electric & Mfg. Company in other respects remains as heretofore.

Trade Publications.

PANELBOARD CABINETS.—The H. O. S. Engineering Company, Newark, N. J., has issued an illustrated price list of several styles of panelboard cabinets, also of covers for panelboards. Each style is briefly described as to construction and material, and some general information on the subject of this make of panelboards is given.

"UNION" ENCLOSED FUSES.—Bulletin No. 16 of the Chicago Fuse Wire & Manufacturing Company, of Chicago, New York and Buffalo, describes a complete line of enclosed fuses and blocks for all kinds of services. "Union National Code Standard" blocks are made of the highest grade of electrical porcelain, with mountings of heavy brass and phosphor-bronze springs. The bulletin also describes extra fittings, suitable for panel and switchboard work, with and without fuses.

REVERSING SWITCHES.—The Cutler-Hammer Manufacturing Company, in Bulletin No. 52 of its perpetual catalogue, describes reversing switches for freight elevators, etc., which are made in the board style for capacities from 1 to 3 hp, and in the drum style for capacities from 4 to 15 hp. Complete diagrams of connecting circuits are also included, so that the wireman should experience no difficulty in inserting the switches in any circuit for which they are intended.

THE CURTIS STEAM TURBINE.—As is well known the Curtis steam turbine is an American invention, and is built in America by the General Electric Company. For several years the British Thomson-Houston Company has been manufacturing these turbines at its Rugby works, and has now got thoroughly organized for producing them on a large scale, and, as this seems to be the age of steam turbines, the manufacture has naturally attracted a good deal of attention among engineers in general in Great Britain, and those from foreign parts visiting that country. The Rugby factory of the British Thomson-Houston Company has already turned out a large number of these turbines which are successfully installed in Great Britain. The British Thomson-Houston Company has recently issued bulletin No. 2060, describing the Curtis turbine in detail, and giving a number of views of the interior of the shops at Rugby.

WATT-HOUR METERS.—In Bulletin No. 90,531, the Stanley Instrument Company, Great Barrington, Mass., presents the advantageous features of the rotating jewel bearing recording wattmeter for alternating-current circuits. It is stated that with a certain 10-amp. meter of this type which registered the equivalent of 120,000 kilowatt hours, thereby necessitating that the disc rotate more than 150,000,000 times on the jewel bearing, no change in accuracy can be discovered at any load from 25 watts to 50 per cent. overload. It is interesting to observe that on a basis of 10 cents per kw-hour, the energy which was recorded by the meter represented a revenue of $12,000.

CATALOGUES WANTED FOR BOHEMIA.—Exporters and importers would greatly oblige our consul at Prague, capital of the Kingdom of Bohemia, by addressing to his consulate their latest catalogue, together with the following commercial information: Name of firm, street, city and cable address; codes used; export discounts and terms; languages of correspondence; references or commercial rating; nature of exports and imports; list of foreign branches and agents; supplementing this with complete information permitting immediate sales—thus getting rid of irritating epistolary angling. This will be filed gratis by firms and merchants in the Commercial Intelligence Department of the Consulate of Prague, by the card and catalogue system devised by our consul at this point. The kingdom of Bohemia has a population of over 6,000,000 and that in the very heart of Europe, and is practically virgin territory for American exporters.

News of the Trade.

THE L. M. ERICSSON TELEPHONE MANUFACTURING COMPANY, it is stated, will erect a factory on Ontario Street, Buffalo, N. Y.

THE NATIONAL BATTERY COMPANY, of Buffalo, N. Y., will have an extensive exhibit in the rotunda of the Brown Palace Hotel, Denver, Col., during the coming convention of the National Electric Light Association. The exhibit will be in charge of Mr. J. Walter Gillette, general sales manager.

SUPPLIES AT ELLENSBURG, WASH.—Mr. Geo. Hornbeck is opening a store for the handling of all electrical supplies, such as motors, fans, heating apparatus and house supplies. Mr. Seth Hodges, formerly manager of the Kent Electric Company, will be associated with him. Catalogues and price lists are solicited.

THE LOCKER MANUFACTURING PLANT of Merritt & Co., Camden, N. J., was visited by fire on May 23, but the damage was confined to the paint rooms, shipping department and one stock room. The loss was fully covered by insurance and there will be no delay in filling orders, as the manufacturing department was not injured at all, but was running as usual the day after the fire.

THE DENVER MINT BUILDING.—Visitors to the Denver convention will undoubtedly be interested in inspecting the new Denven Mint building and plant. From a mechanical standpoint, this is said to embody the latest improvments in the lines of machinery and engines. Appreciating the important part that lubrication has to the perfect performance of machinery, it may be noted that Harris oils have been adopted and are used. While many of the visitors may be familiar with the quality of this product, there are others to whom this will serve as a practical demonstration. Harris oils are manufactured by the A. W. Harris Oil Company, Providence, R. I.

EASTERN ELECTRIC CABLE & WIRE COMPANY.—Mr. Augustus Daniels has bought, at receiver's sale, all of the real estate, machinery, stock, good will and trade marks of the Eastern Electric Cable Company, and at once commenced business under the name "Eastern Electric Cable & Wire Company." The company is adding new machinery to increase its facilities for turning out promptly high grade insulated wires. Among the special brands of wires manufactured by this company are three sizes of "Red automobile Wires." Mr. Homer M. Daggett is general manager of the company, the address of which is 61 Hampshire Street (Roxbury District), Boston, Mass.

REMOVAL NOTICE.—On May 1, 1905, W. N. Matthews & Bro., the well-known manufacturers of the Stombaugh guy anchor, moved their offices and store rooms to 227 N. 2nd Street, St. Louis, Mo. This was made necessary because of the large increase in their business. They state that the sales of the Stombaugh guy anchor have increased to such an extent that they have to carry a large stock in St. Louis for shipment to points west of the Mississippi River, and therefore require more room. All shipments east of the Mississippi are made from Chicago, Ill., Cleveland, Ohio, Sidney, Ohio, and New York City. The Stombaugh anchor was first put upon the market in 1899.

REYNOLDS FLASHERS.—Owing to the great rush of business at the present time, Mr. C. F. Ziegler, president of the Reynolds Electric Flashers Mfg. Company, of Chicago, will not be able to attend the convention at Denver, but he will be represented there by Mr. F. A. Bennett, who will have headquarters on the eighth floor of Brown's Palace. Mr. Bennett is favorably known among the electrical fraternity and will make a valuable substitute for Mr. Ziegler. He will have a number of the celebrated Reco and improved Reynolds flashers on exhibition and will take pleasure in explaining their qualities to all who are interested. This will be an excellent opportunity for those who attend the convention to see these ingenious machines in operation.

TELEPHONY IN MEXICO.—The rapid development of Mexico has created a large field for telephone and electrical equipment of all kinds. To fill the needs in this direction, the Mexican General Supply Company has recently been organized, with its main office and supply house at Chihuahua, where it will carry the main stock of a full line of electrical equipment of every kind, mining machinery and supplies, and a complete line of telephone apparatus. To be in position to furnish complete public exchange telephone equipments, as well as mining, street railway and other private exchange systems, together with municipal police signalling and telephone systems of the most modern, efficient and durable type, and best adapted for the work the company has in contemplation, arrangements have been made for handling the business in the Republic of the International Telephone Manufacturing Company, Chicago.

H. T. PAISTE COMPANY, Philadelphia, Pa., reports very satisfactory sales of its line of "P-K" panel and entrance cut-outs. This line, up to the present time, has comprised eight different styles of cut-outs for the use of the contractor. These standard panel cut-outs are used generally where main feed wires enter the panel boxes at the top and the branch circuits are carried out at the side of the boxes. It was soon found, however, that other conditions were to be met, as the contractor has often needed to bring his main wires into the side of the box to carry his branches out either at the top or bottom. The national electrical code rules for wiring require that switches shall be hinged in such manner that gravity will tend to open them instead of close them. This rule in panel box work necessitates an entirely new lot of these blocks which H. T. Paiste Company now has ready for the market with switches hung as required. Circulars giving full information and illustrations will be sent upon application.

THE STUART-HOWLAND COMPANY, of Boston, is showing considerable activity in pushing the sale of its supplies throughout the United States and Canada. It has recently established agencies in Halifax, N. S., Winnipeg, Manitoba and Los Angeles, Cal. It has also added to its force of travelling salesmen Mr. J. Brinton Bailey, formerly in the employ of Sampson & Allen, contractors in Lynn, and Mr. J. T. Hessel, for many years connected with the Western Electric Company and more recently with the Carleton Chase Company of New York. At a recent visit to the Boston offices of that company we were informed that its business so far this year was considerably in advance of any year in its history, and this report was confirmed by observation of the general activity around its warerooms and especially in the shipping department. The large and spacious warerooms were filled to the limit with a well assorted stock of railway, telephone and lighting supplies. A further evidence of this company's activity is shown in the fact that it has recently acquired several valuable exclusive selling agencies. The Stuart-Howland Company now ranks among the three or four largest electrical supply houses in America, and judging from the recent acquisitions to its selling department above referred to, and to its shipping force as well, there is every indication that it proposes to keep abreast of the procession.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Stadtler, 39 S. 10th St., Philadelphia.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, New York City, Sept. 19, 20 and 21, 1905.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope. 95 Liberty Street, New York. Meetings, last Friday each month. Annual convention, Asheville, N. C., June 19 to 23.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, Montreal, Can., Sept. 5, 6 and 7, 1905.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Denver, Col., May, 1906.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Montreal, June 21, 22 and 23, 1905.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ELECTRICAL ASSOCIATION OF NORTH DAKOTA. Secretary, S. J. Fuller, Larimore, N. D.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association.) Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, D. Davis, Litchfield, Ill.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Annual meeting, second Thursday in January, 1906. Monthly meetings, second Thursday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Erie, Pa., Aug. 29, 30 and 31, 1905.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, June 20 and 21.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia.

IOWA ELECTRICAL ASSOCIATION. Secretary, P. E. Bellamy, Knoxville, Ill. Next meeting, Des Moines.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederick P. Vose, 1343 Marquette Building, Chicago.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, J. E. Davidson, Port Huron, Mich.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, Baltimore, Md., October, 1905.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, Boston, July 19, 1905.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Dudley Farrand, Newark, N. J. Next meeting Denver, and Colorado Springs, Col., June 6-11, 1905.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, T. S. Lane, 536 Ellicott Square, Buffalo, N. Y. Next meeting, Albany, N. Y., June 16, 1905.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. E. Knox, Portsmouth, O.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Hotel Victory, Put-in-Bay Island, Aug. 16, 17, and 18, 1905.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, 620 Shorb Street, Canton, Ohio.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal. Next meeting, Portland, Ore., June 20, 1905.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second Street, Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, C. W. Hobson.

SOUTH DAKOTA TELEPHONE ASSOCIATION. Secretary, H. B. Hartwell, Irene, S. D. Next annual convention, Sioux Falls, S. D., second Wednesday in January, 1906.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Lake George, June 27 and 28.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STREET RAILWAY & ELECTRIC ASSOCIATION. President, R. D. Apperson, 723 Main St., Lynchburg, Va.

WESTERN SOCIETY OF ENGINEERS, Electrical Section. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 23, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

790,303. BURGLAR ALARM; John E. Liess, Chicago, Ill. App. filed Nov. 13, 1903. The circuit which includes the various breaks of the burglar alarm, also has therein a relay magnet which acts to release a clock-work mechanism or train of gears which propels a rotary member. The rotary member has contacts thereupon to establish the alarm circuit for any desired period of time. The apparatus then automatically comes to a state of rest in a position to receive a second alarm.

790,309. ELECTRICAL VETERINARY APPLIANCE; Albert Paxton, Montpelier, Ind. App. filed Sept. 15, 1904. Upon the saddle of a horse or other animal is adapted to be mounted an induction coil set, including a battery and terminals extending to contacts adapted to be wrapped about the knees or feet of the horse.

790,320. RAILWAY SIGNALING SYSTEM; Benjamin F. Saurman, Philadelphia, Pa. App. filed Oct. 8, 1904. A portion of the train, and preferably the locomotive cab has pending therefrom an arm carrying a wheel which is maintained adjacent to the track. In the path of this wheel are cams projected upward by the semaphore signals. When the wheel passes over a cam, a ratchet pawl steps around a colored disc, which displays the proper signal within the locomotive cab.

790,368. ALTERNATING CURRENT MACHINE; Charles W. Johnson, Norwood, O. App. filed Oct. 30, 1903. Relates to the construction of the windings of armatures, or of the rotor in an alternating current machine. Fixed on the end of the rotating element is an annual ring of U-section with perforations in its inner face. The conductors are guided through said perforations by insulating material secured in the channel of the annual part or ring.

790,381. SUPPORT AND CASING FOR CONTACTORS; William O. Mundy, St. Louis, Mo. App. filed Feb. 20, 1903. The contactor box is secured to the bottom of the car and includes a removable side of bulging form which is connected to the box through intermediate links. When swung up into position it is held by a gravity catch and is adapted to slide beneath the box when opened so as to take up a minimum of space.

790,414. ALTERNATING-CURRENT COMMUTATOR MACHINE; Gabriel Winter, Vienna, Austria-Hungary, and Friedrich Eichberg, Berlin, German. App. filed Aug. 24, 1903. (See Current News and Notes.)

790,428. TELEPHONE TRANSMITTER; Harry M. Gail, Buffalo, N. Y. App. filed July 7, 1904.

790,434. TROLLEY; John B. Humphrey, Louisvile, Ky. App. filed Sept. 21, 1904. The head or bearing support of the trolley wheel is pivoted to the trolley pole by a ball-bearing connection permitting a relative swinging movement of the parts in a horizontal plane.

790,450. SWITCH-OPERATING MECHANISM; Elisha Moore, Boston, Mass. App. filed July 19, 1904. A track switch having a connection from the insulated trolley section through a main operating magnet in the roadbed adjacent to the switch. When the circuit is closed by a passing car, the energization of the magnet moves the switch to its other position wherever it initially happens to be.

790,471. DYNAMO ELECTRIC MACHINE; Edwin C. Wright, Newport, Ky. App. filed Sept. 30, 1904. Relates to a construction of rotor, or the rotating field for alternating current machines. The windings are symmetrically arranged and dovetailed into longitudinal channels, and the end connections are guided between the walls of an annular recess at the end of the rotating element, insulating spacing blocks being provided to separate the connections and permit a thorough ventilation of the parts.

790,472. SYSTEM OF DISTRIBUTION FOR MULTIPLE-GLOWER LAMPS; Alexander Jay Wurts, Pittsburg, Pa. App. filed Nov. 9, 1900. (See Current News and Notes.)

790,475. DYNAMO ELECTRIC MACHINE; Bernard A. Behrend, Norwood, O. App. filed Sept. 19, 1904. Includes certain details of improvement over patent 790,471, particularly with reference to the clamping means for holding the end connections in proper relation. The connections are here held against their outer containing surface by an expansible ring operated by a conical wedge on the shaft.

790,485. ROTOR CONSTRUCTION; Louis H. Dunker, Norwood, O. App. filed Sept. 19, 1904. The parts are constructed so as to permit ventilation throughout. The laminations are separated and the windings dovetailed into grooves there through. The end connections are made in a box or casing perforated for ventilation, and include spacing blocks and wedges of particular form to secure strength of construction and complete ventilation throughout.

790,499. ELECTRIC LAMP; Marshall W. Hanks, Pittsburg, Pa. App. filed July 14, 1900. (See Current News and Notes.)

790,525. ELECTRIC GLOWER LAMP; Henry Noel Potter, Gottingen, Germany. App. filed Aug. 14, 1899. (See Current News and Notes.)

790,538. PROTECTED THIRD-RAIL ELECTRIC RAILWAY SYSTEM; Henry A. Thomsen, New York, N. Y. App. filed Feb. 12, 1904. The third rail is protected by a sheathing of sheet metal forming a hood or covering therefor. The different sections of the casing are lap-jointed together and an insulating material is included between the joints.

790,541. CONTROLLER FOR ELECTRIC MOTORS; Walter J. Warder, Jr., Chicago, Ill. App. filed Sept. 26, 1904. A controller box of ordinary form has the usual starting and reversing cranks thereon. An arm is also formed on the starting crank having a roller engaging a cam piece upon the reversing crank, so as to shift the latter when the former is rotated backwardly. The parts are so formed that the reversing drum can only be operated when the handle is in its off position.

790,548. ANNUNCIATOR; George F. Atwood, New York, N. Y. App. filed June 18, 1904.

790,550. PARTY-LINE TELEPHONE; Henry Melvin Bascom, Brooklyn, N. Y. App. filed Sept. 12, 1904.

790,551. ELECTRIC LAMP; Edward Bennett, Pittsburg, Pa. App. filed Sept. 26, 1903. (See Current News and Notes.)

790,569. ELECTRIC MACHINE; Albert F. Hemingway, Chicago, Ill. App. filed Aug. 15, 1904. (See Current News and Notes.)

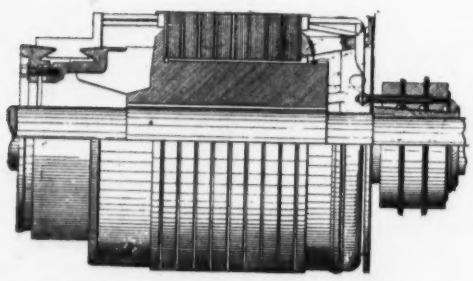
790,581. INDUCTANCE AND INDUCTION COIL FOR ELECTRICAL APPARATUS; Dimmitt R. Lovejoy, Niagara Falls, N. Y. App. filed Aug. 19, 1903. The induction coil is built up of individual flat sections placed end to end in the usual way. The patent relates to the construction of these individual winding or spool supports. Each is made of strawboard stamped into form by a die press.

790,603. MICROPHONE; Paul Julien Tariel, Issy-Les-Moulineaux, France. App. filed June 30, 1904.

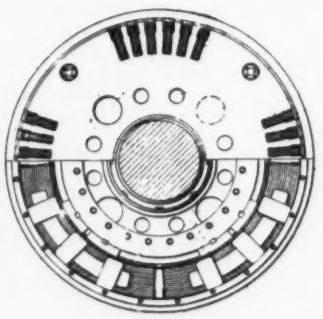
790,655. MEDICAL OZONIZER; Marius Otto, Paris, France. App. filed June 6, 1903. An induction coil of the usual form has terminals connected to a pair of condensers. The opposite terminals of the condensers lead through resonators of special form whereby the resonance can be varied, and finally terminate in an ozonizer tube through which the patient may inhale the ozonized air.

790,684. TELEPHONE CALL ATTACHMENT; Joseph Harveston and John O. Mudgett, Santa Cruz, Cal. App. filed Dec. 16, 1904.

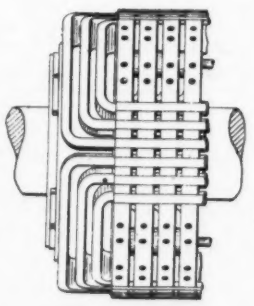
790,730. APPARATUS FOR EXHAUSTING INCANDESCENT LAMP BULBS; Christian Hoelscher, Warren, O. App. filed Feb. 15, 1905. Includes a longitudinal main pipe having an air pump at each end, and branches adapted for connection with the bulbs to be exhausted. Other branches contain chemicals and are adapted to supply the desired carbonating gases. The cocks or valves are manipulated in a special way so that some of the lamps are being exhausted while others are being sealed off or otherwise treated. The duplicate air pumps are designed to supplement one another and reduce the time required for the necessary operations.

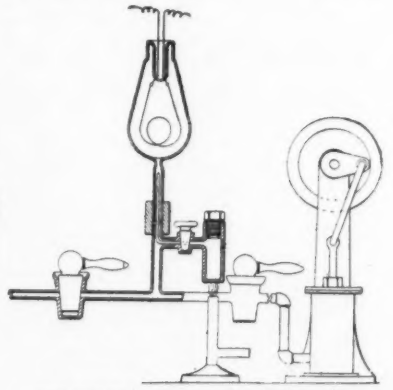


790,368.—Alternating-Current Machine.



790,485.—Rotor Construction.





790,730.—Apparatus for Exhausting Incandescent Lamp Bulbs.

790,753. ELECTRIC CLOCK SYSTEM; Wiliam A. Roberts and Edward T. Robinson, St. Louis, Mo. App. filed Mar. 19, 1904. The master clock has a contact spring adjacent to the usual escape wheel which closes the local circuit of a relay magnet and transmits impulses to the line. The secondary clocks have magnets for actuating the escape pawls.

790,789. ELECTRIC CUT-OUT SWITCH; Joseph Frechette, Pawtucket, R. I. App. filed Apr. 11, 1904. A rock-shaft has a projecting rib or arm thereon which raises spring contacts so as to break their connection with plates beneath, thereby interrupting the lighting or other circuit. A further movement of the rock-shaft finally releases the spring arms so that they return and again close the circuit when desired.

790,812. ELECTRIC TELEPHONE SWITCH; George F. Archer, New York, N. Y. App. filed Oct. 15, 1903.

790,814. MULTIPLE SWITCH FOR TELEPHONES; Charles V. Beaver, Anita, Ia. App. filed Dec. 7, 1901.

790,819. MEANS FOR CONTROLLING ELECTRIC CURRENTS; Gerald J. Dorman, Brooklyn, N. Y. App. filed Oct. 16, 1902. The regulator resistance of the generator is controlled by an arm swung back and forth by a pneumatic cylinder. A main line solenoid actuates a two-way valve to supply air to the appropriate end of the cylinder. Additional solenoids serve to connect accumulators to the generator circuit under certain conditions.

790,822. FIRE ALARM APPARATUS; Harry T. Gale and Ransom W. Davenport, Buffalo, N. Y. App. filed May 7, 1904. The fire-alarm box is located within a housing having a door. An electrically operated lock is adapted to maintain the door in closed relation, when its circuit has been closed by a person operating the alarm. The floor of the housing is connected into the circuit so as to insure that an alarm shall not be given, or the door locked unless a person is within the housing.

790,838. ELECTRICAL DEVICE OR CIRCUIT; Robert J. Hewett, Westfield, N. J. App. filed Aug. 11, 1904. Involves a complete railroad signal system in which two semaphore signals are displayed at each block to indicate the condition of the two preceding blocks in the usual way. The device is designed to do away with polarized relay magnets and mechanical connections between the stations. The circuit-closing magnets have different resistances and the circuits are made in such a way as to operate different magnets at different times.

790,854. TELEPHONE SYSTEM; John G. Roberts, Evanston, Ill. App. filed May 8, 1902.